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*Special Edition:
50th Anniversary of the
Faculty of Education*

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EDITORIAL

You've Come a Long Way!

I am delighted as the eighth dean of the Faculty of Education, and as one who was privileged to publish in the first volume of the *Alberta Journal of Educational Research*, to comment briefly about the Faculty of Education in this issue commemorating the 50th Anniversary of our Faculty.

First, let me provide you with a bit of information about our history. The Faculty of Education at the University of Alberta was established on April 11, 1942. Therefore, during the academic term 1991-1992, the Faculty and its friends are celebrating the 50th Anniversary of an event that is significant not only to education in the Province of Alberta, but also to the development of education in Canada and in countries around the world.

Our Faculty had modest beginnings. The first course in education at the University of Alberta was approved by the Senate in 1911. By 1922 instruction was being offered in the philosophy of education, educational psychology, history of education, and educational administration. These early efforts evolved in stages through a School of Education administered by the Faculty of Arts and Science, a College of Education, and finally, in 1942, the Faculty of Education.

Creation of the Faculty set the stage for the decision by the province to close its normal schools in Calgary and Edmonton and to turn control of teacher education over to the University of Alberta in 1945. Alberta was the first province in Canada to make teacher education exclusively a university responsibility. The Faculty became the largest and strongest in the country and gained strong governmental and university support not enjoyed by most such faculties in Canada.

While I am in this boasting mode, let me tell you a few more facts about the Faculty of Education at the University of Alberta:

- during its 50-year history, it has awarded over 39,000 BEd degrees;
- approximately one third of the deans of faculties of education in Canadian universities are graduates of this Faculty;
- the Faculty has supplied more faculty members for faculties of education across Canada than any other institution;
- this year we have in attendance approximately 5,000 students, 5,000 undergraduates, and 1,000 graduates (700 MEd and 300 PhD);
- the teaching staff has grown from three full-time instructors in 1942 to an FTE well over 200 in the seven teaching departments;
- during 1990-1991, the Faculty of Education made 4,659 practicum placements;
- in 1942 the Faculty offered 12 education courses; in 1992 the Faculty offers 332 courses;

- in 1989-1990 graduate degrees in education were awarded to residents of 17 countries: Australia, Belize, Canada, Ghana, Hungary, Iceland, Jamaica, Japan, Mexico, Papua New Guinea, The People's Republic of China, South Korea, Sri Lanka, Tanzania, Thailand, the United States of America, and Zimbabwe;
- the Faculty has been involved in teacher preparation programs in Thailand, Tanzania, Korea, China, Uganda, Nepal, India, and Australia.

In closing let me compliment the present editor Dr. Rob Short and all his predecessors for the important role they have played in creating and sustaining a journal of such wide acclaim. Academic communities are concerned with the dissemination of knowledge as well as the extension of knowledge. Teaching is our main concern, but research (the application of systematic intellectual curiosity applied to the borders of knowledge) is required by the teaching function. I am convinced that the *AJER* has contributed significantly to both of these roles. These contributions over the life of the Journal since its inception in 1955 have been recognized and noted by many world class scholars. Thus I consider it appropriate to applaud the *AJER* by citing the oft quoted expression, "You've come a long way, baby!" Keep up the excellent job!

Harvey Zingle

Editor's Note

I would like to take this opportunity as the new editor of *AJER* to thank my immediate predecessor Tom Maguire for the enormous effort, skill, and enthusiasm that he brought to the position. Taking over from Tom is a daunting task. Everything that he accomplished in his three years as editor was with a thoroughness and ability impossible to equal. This issue of *AJER* was planned under Tom's stewardship. To commemorate the 50th Anniversary of the Faculty of Education at the University of Alberta he asked six members of the Faculty who are actively involved in educational research to write articles for the Journal. I believe that the resulting contributions reflect the wide range of research activity and interests at the University of Alberta. Thank you, Tom.

RHS

ERWIN MIKLOS

University of Alberta

Trends in Doctoral Research in Educational Administration

A review of 319 doctoral theses in educational administration completed at the University of Alberta between 1958 and 1990 revealed that both the research topics and methodologies were highly varied. The two main goals of the research were to describe and to study relationships. Two main research strategies—survey and case study—were dominant. Questionnaires, interviews, and documents were widely used as sources of data, frequently in combination. Over a period of more than three decades, the proportion of descriptive studies increased while the proportion of relational studies declined. The proportion of studies using case study strategies, interviews, and multiple methods of data collection also increased. When considered in combination, the trends indicate major shifts in the nature of research conducted by doctoral candidates in educational administration.

Educational administration as an area of specialized study has a relatively short history. In most Canadian universities, graduate programs in educational administration were established only in the 1960s and 1970s. Although research is an essential aspect of graduate study, the field has been slow to focus attention on the nature of those research activities. Until recently, there were virtually no books specifically on the subject of research in educational administration. While there have been reviews of research in various areas, critiques of the nature of the research are at times based more on general impressions than on concrete data. Considerations such as these prompted a project that promised to offer additional insights into the state of research in the field of educational administration.¹

Purpose and Approach

The general purpose of the project on which this paper is based was to review a series of doctoral theses in order to gain a better understanding of the nature of research actually conducted in and on educational administration. The review was restricted to doctoral theses completed in the Department of Educational Administration at the University of Alberta from the time of submission of the first thesis in 1958 to the end of 1990. In some respects, the project may be viewed as a form of case study of research in educational administration.

Among the specific questions defined to guide the review were the following: What are the general characteristics of doctoral research in educational

Erwin Miklos was formerly a professor in the Department of Educational Administration. He currently holds a part-time, postretirement appointment that involves him in both teaching and research activities in the Department.

administration? What purposes, strategies, and methodologies characterize the research? What trends, if any, are evident over time in the characteristics of the research? What insights does the doctoral research offer into the general nature and evolution of research in educational administration? Additional research questions focused on the substantive themes and outcomes of the studies.

The approach that was adopted to addressing the research questions involved identifying a number of aspects of each thesis including the problem statement, the conceptual basis of the study, the research methodology used, and the major findings. In each of these areas, categories were established based on the characteristics of the studies themselves. Although the analysis was influenced to some degree by a priori categories, the general approach was one of trying to organize the data in a manner that would provide a meaningful representation of the nature of the research. The focus of this article is on the characteristics rather than on the substance of the studies. In order to identify trends, results of the analysis are presented for three time periods—1958 to 1970, 1971 to 1980, and 1981 to 1990—that are referred to on occasion as *decades*.

Following a comprehensive analysis of the characteristics of the research, the article shifts to a discussion of research emphasis and trends before ending with a concluding note.

Characteristics of the Research

The research reported in doctoral theses is characterized by diversity. A multiple classification scheme was required in order to develop an adequate description of the nature of the research. The basis of the description selected for this analysis revolved around the purposes served by the research, the general research strategy, and the essential features of approaches to the collection and analysis of data. Although terminology adopted for these descriptions was intended to be consistent with that in general use, some slight departures were necessary in order to reflect accurately the distinctive aspects of the research.

Types of Studies Based on Purpose

Research projects differ in terms of general goals; consequently, one basis on which studies may be classified relates to the purposes identified by the researcher. A preliminary examination of the theses under review suggested that six purposes would provide an adequate basis for a classification. The terms selected for the typology—descriptive, relational, evaluative, developmental, conceptual, and methodological—reflect the major possibilities in the intended outcomes of a particular research project. While most studies could be accurately described by single terms, combinations of terms such as descriptive/relational were required in order to categorize studies with multiple objectives. The placement of theses in specific categories was complicated in some instances by lack of clarity about the intent of the study. Consequently, the substance of the entire thesis and not just the statement of purpose was assessed in determining the category in which a particular study might accurately be placed.

Descriptive studies. In the studies categorized as descriptive, the intent of the researcher was to describe a particular event, practice, process, group, organization, or other phenomenon. Many descriptive studies might more appropriately have been labeled descriptive/analytical because researchers tended to go beyond description to probe for similarities or differences, to identify trends, and to offer possible explanations for findings. Studies in the descriptive category covered a broad range of research into a variety of specific topics.

The variety both in areas of interest and in more specific objectives of doctoral candidates for doing descriptive research is indicated by some illustrative themes and examples. Descriptive research has been conducted

- to determine the extent to which certain developments or changes in education have taken place, such as those on the regionalization of educational administration in various provinces (Chapman, 1974) or on community schools (Sullivan, 1976);
- to trace historically a particular development such as provisions for financing education (Warren, 1962), evolution of the formal structure of separate schools (Fenske, 1968), or development of native education (Daniels, 1973);
- to describe the process of how a decision was made or how a policy was developed and implemented as in Housego's (1964) study of a teacher training issue or Tymko's (1979) analysis of the policy on high school accreditation;
- to describe and analyze practices which are not well understood, for example, control over decisions (March, 1981), behavior of administrators (Duignan, 1979), leadership (Thorpe, 1989), or the selection of superintendents (Van der Linde, 1989);
- to determine attitudes towards or beliefs about various aspects of the operation of educational systems such as financial constraint (Ell, 1988) or inservice education (Pansegrau, 1983);
- to develop guidelines for practice based on a consolidation and interpretation of data from various sources such as legal studies that involves an examination of statutory law and court cases to identify basic principles that have implications for administrative practice (Bargen, 1959; Cooze, 1989; Enns, 1961); and,
- to describe specific organizations (Valentine, 1988) or organizational processes such as change (Alpern, 1986).

Many of the theses that were placed in the descriptive category were justified in terms of contributing to knowledge through providing a description of practice as a point of departure for identifying possibilities for change and improvement.

Relational studies. The primary purpose of the researchers who completed relational studies was, of course, to determine the nature of the relationships between or among certain variables. In general, all of the researchers whose theses fell into this category attempted to establish the plausibility of the relationship to be tested; however, many tended to be cautious and described their studies as "exploratory" in nature. While some

stated hypotheses explicitly, others left them implicit; questions rather than hypotheses were frequently used to guide the data analysis.

As is indicated by the examples, relational studies have focused on a diversity of areas including

- interrelationships among characteristics or behaviors of groups and individuals such as professional role orientation and social interaction (Scharf, 1967);
- interrelationships among characteristics of administrators such as personality variables and innovativeness (Marion, 1966), and principals' job satisfaction and perceptions of effectiveness (Johnson, 1988);
- relationship of organizational variables to individual variables, for example, school climate and teacher behavior (Harvey, 1965) or values and organizational climate (Lupini, 1965);
- relationship of structural characteristics to some measures or indicators of effectiveness (Rourke, 1983); and,
- relationships involving environmental variables such as demographic factors and school attendance (Drolet, 1961).

Although the studies cited above are primarily relational, some also have description as an implicit purpose.

Descriptive/relational studies. A significant proportion of doctoral thesis research might best be described as descriptive/relational in that the researcher attempted to achieve two purposes: to present descriptive data on an area of interest and to examine relationships among selected variables. Researchers who have completed descriptive/relational studies defined the specific purpose in a variety of ways. Some did include *to describe* as an explicit part of the problem statement. However, others tended to use a more general term such as *to analyze, to examine, to explore, to investigate, to identify, or to compare*.

As is true of both descriptive and relational studies, descriptive/relational research problems have addressed various specific topics. Among these has been research conducted

- to analyze structure and performance of school organizations (Hersom, 1969);
- to examine the nature of member involvement in a teachers' organization (Ingram, 1965) or burnout as a stress response among principals (MacPherson, 1985);
- to investigate relationships between professional role orientations and bureaucratic characteristics (Robinson, 1966) or job satisfaction of school principals (Rice, 1978); and,
- to identify and describe the nature of prestige hierarchies within the teaching profession (Bride, 1973).

Other examples would be similar to those identified in the discussion of relational studies.

Evaluative studies. In this classification, evaluative studies were those that revolved around assessing the merits of a particular program or practice. The purpose or intent of the researcher was to examine and to make judgments about consequences, outcomes, or effects. Some evaluations were

directed specifically at innovations or new programs while others focused on continuing practices.

The conceptual bases of evaluative studies may reside only partially in a particular theory of evaluation and may draw on other areas as well. Dickie (1983) based his evaluative study on a particular evaluation model, whereas Fraser (1974) and Bethel (1981) based their research on the more general evaluation literature as well as that on organizational effectiveness. Still others, such as Aidoo-Taylor (1986), developed a model for assessing the practice under investigation.

Some evaluative studies had a sufficiently strong descriptive component to warrant the designation of descriptive/evaluative studies. They had no distinctive characteristics other than this particular set of dual objectives.

Developmental studies. In general, developmental projects had the characteristics of what is usually referred to as research and development in education. Developmental projects were oriented primarily toward designing a “product”—a procedure, a program, or a policy—assumed to be of direct interest to the practice of administration. Some testing or evaluation of the product was usually involved.

An indication of the range of possibilities is provided by some of the studies that fell into this category:

- a computer-based model of supply of and demand for teachers (Richards, 1971);
- a program information system for a college (Murphy, 1976), a model for monitoring an educational system (Collett, 1981), and a computer support system for an instructional department (Montgomerie, 1981);
- a program in moral reasoning for use in administrator preparation (Sinclair, 1978); and,
- policy recommendations for the professional preparation of educational administrators (Duncan, 1986).

The conceptual basis of such projects usually was drawn from the relevant literature. In designing the product, the researchers moved from the conceptual to the applied stage.

Conceptual studies. All research has a conceptual base, and some conceptual implications usually can be derived from the results of any particular study. In this regard, all doctoral theses are “conceptual” in some respects. However, certain studies were designed primarily for the purpose of contributing to conceptual development or clarification, and the category of conceptual studies was restricted to those specifically dedicated to achieving this purpose. In a conceptual study, the intent of the researcher was to test or to analyze critically an existing theory or to develop a new conceptualization, construct, or theory.

The general nature of conceptual studies is illustrated by the following examples:

- testing the applicability or validity of a particular theory or model such as the bureaucratic model (Allison, 1980; MacKay, 1964), Fiedler’s theory of leadership (McNamara, 1968), or selected models of change (Peters, 1986);

- clarifying concepts of faculty vitality (Nicolson, 1988) or of different approaches to planning (Moore, 1973);
- generating hypotheses or theories related to areas such as the developmental stages of teachers' growth during their careers (Williams, 1986), or the process of educational innovation (Prebble, 1975); and,
- developing an alternative conceptual model such as of organization (Deblois, 1976) or of the policy making process (Kunjbehari, 1981).

Studies that had a conceptual purpose were usually designed in combination with other objectives such as describing certain phenomena, exploring relationships, or developing methodologies.

Methodological studies. In a methodological study, the intent of the researcher was primarily to test the applicability of a research procedure or to develop a new research technique. Although various theses may have made a contribution to the development of research methods, only those that had a fairly explicit methodological objective were placed in this category.

Methodological studies have been directed specifically toward developing instruments, testing research procedures, or developing a new procedure. The specific objectives of methodological studies have taken forms such as

- to construct measures of the organizational structure and operation of secondary schools (Kelsey, 1973), or to develop an instrument to describe dimensions of the teaching-learning process (Stryde, 1973);
- to test the applicability of the techniques developed by Bellack for the analysis of verbal interaction at school board meetings (Holdaway, 1968); and,
- to develop a procedure for examining structural changes in organizations over time (Heron, 1972), or a classification system and a method of analyzing the content of communications (Adams, 1973).

Most studies that placed a significant emphasis on the methodological purpose also gave some attention to the conceptual aspect.

Trends in types of studies. The distributions by percentages of the 319 theses for each type of study across three time periods—1958 to 1970, 1971 to 1980, and 1981 to 1990—are shown in Table 1. About 46% of all theses are primarily descriptive in nature, 16% are relational, and 23% are descriptive/relational. The other types—evaluative, developmental, conceptual, methodological—both singly and in combination—comprise only about 15% of all theses. Only 6% of theses have an evaluative component, and only about 8% have either a conceptual or a methodological focus. Only 2% were classified as being developmental. Although varied intents were evident in the research pursued by doctoral candidates, the main purposes were to describe and to study relationships.

An examination of the percentages across the three decades reveals some changes in types over time. The proportions of descriptive studies increased from about one third in the first decade to well over half in the third, whereas relational studies declined from over one in four to about one in 12. The proportion of descriptive/relational studies decreased from the first to the second decade and then remained steady. The shift in types would seem to be from a decreasing emphasis on relational studies to an increasing emphasis

Table 1
Percentage Distribution of Theses by Type Based on Purpose

Type of Study	1958- 1970 N = 74	1971- 1980 N = 112	1981- 1990 N = 133	Total N = 319
Descriptive	32.4%	42.0%	56.4%	45.8%
Relational	27.0	17.0	8.3	15.7
Descriptive/Relational	31.1	19.6	21.1	22.9
Evaluative	0	4.5	6.0	4.1
Descriptive/Evaluative	1.4	1.8	2.3	1.9
Developmental	0	2.7	2.3	1.9
Conceptual	0	2.7	0.8	1.3
Conceptual/Descriptive	0	2.7	3.0	2.2
Conceptual/Descriptive/Methodological	0	2.7	0	0.9
Conceptual/Methodological/Relational	1.4	1.8	0	0.9
Conceptual/Relational	2.7	2.7	0	1.6
Methodological/Relational	4.1	0	0	0.9

on descriptive studies. Evaluative studies emerged primarily in the second decade but did not increase substantially in the third. No patterns are evident in the other types of studies because of the low proportions.

Research Strategies

A second basis for classifying theses relates to the general strategy, method, or design that characterized the research project. Seven major research strategies provided a comprehensive basis for categorizing the thesis research: survey, case, case/survey, comparative, causal-comparative, experimental and panel. Only 10 of the 319 theses could not be placed into one of these categories necessitating an "other" category.

Surveys. Researchers who used a survey strategy collected data from a sample in order to draw conclusions about the population from which the sample was selected. A major variation in survey research related to the sampling procedures. Variety in approaches to sampling rather than a convergence toward a limited number of methods was the general characteristic of survey strategies in thesis research.

Random sampling was used in surveys that related to relatively large as well as to smaller populations. Some studies involved a random sample of teachers in a province, whereas others were somewhat more limited as a random sample of all principals in a province, or still more limited such as a sample of academic staff in one university. Stratified sampling was used to select samples of administrators, samples of regional offices of education, and samples of teachers and administrators. All members of a population were the focus of some surveys (March, 1981; Van der Linde, 1989).

Cluster sampling has been used as a manageable and defensible strategy for collecting data on variables of interest to researchers in educational

administration. Sometimes there may be sequential cluster sampling; for example, Greenfield (1963) selected a sample of 22 districts, two schools in each district, and two classrooms in each school and then focused on the students in those classrooms. Purposive sampling has also been used. For example, Larsen (1984) selected a sample of 10 nurses in a specified age-range who held earned doctoral degrees. Among other approaches to sampling that were used by researchers are quota sampling, reputational sampling, volunteers, and snowball sampling.

Some surveys involved relatively large samples from a particular school district or a particular organization. For example, both Williams (1981) and Sarros (1986) conducted surveys in one school district involving fairly large samples. In contrast, some surveys have involved only a relatively small number of respondents.

Case studies. Research projects that involved the in-depth examination of one particular individual, group of individuals, organization, event, or series of events were categorized as case studies. A source of variation in case studies was the extent to which a historical perspective entered into the analysis. Some case studies were essentially descriptions of a particular event or phenomenon at one point in time. Examples of this type of case study included the analysis of interpersonal influence in a school (House, 1966), the operation of an urban school board (Martin, 1968), the adoption of a participative governance approach in a college (Kelly, 1973), and the operation of community schools (Quarshie, 1989).

In another type of case study, the historical dimension entered to a degree in that there was an attempt to describe developments over a period of time. Most of the studies on how a decision was made or on how a certain policy was developed or implemented are historical in the sense that some efforts were usually made to describe the antecedents of the events that were of particular interest as well as to trace the evolution of the development. For example, Korteweg (1972) focused on a "decade of social studies curriculum development in Alberta," Kozakewich (1980) linked policy developments to activities of interest groups in two previous decades, and Iles (1984) examined the history of school jurisdictional issues in a particular area to identify conflictual themes.

The third type of case study had a more explicit historical focus in that the researcher sought to describe and search for explanations of what occurred and how this came about. For example, Toombs (1966) analyzed parliamentary debates on federal financial participation for the period 1867-1960, Hodgson (1964) examined the nature and purposes of public schools in the Northwest Territories and Alberta from 1885 to 1963, and Scott (1973) focused on the development of secondary education in Jamaica over a 10-year period.

In pursuing research topics that lent themselves to a case study strategy, some researchers chose to include more than one instance or case in the investigation. These are, in effect, multi-site or multi-case studies. For example, Thorpe (1989) included seven administrators in a study of leadership while Young (1989) developed a biographical study around the life experiences of four female educators.

Case/surveys. Some studies had certain characteristics of a case study in that the focus was on one organization; however, data collection procedures resembled those of a survey. Consequently, there was need for a case/survey category to describe this type of study. Some examples may serve to clarify this research strategy.

Eastcott (1975) used a case/survey approach to examine the perceptions of and preferences for participation in decision making of the members of a university faculty. Since only one particular organizational unit was involved, the study might have been developed along the lines of a case study. However, the researcher was guided by questions and used data collection techniques frequently associated with surveys. A study by Jeffrey (1989) of the relationships between the Alberta Teachers' Association and other organizations also exemplifies the combination of case and survey research strategies.

Comparative studies. Even though comparison was an aspect of data analysis in numerous studies, the category of comparative studies was restricted to those that involved a deliberate strategy of making comparisons between two or more sources of data: individuals, organizations, events, or other phenomena. The decision on placing theses into this category was complicated by the variety of ways in which comparisons entered into the design of studies. Some researchers described their studies as comparative when this was more descriptive of the approach to data analysis rather than to overall research strategy. In others, the comparative nature of the design was not dealt with explicitly by the researcher.

Among those researchers who made the comparative nature of the study explicit was Maddocks (1972) in an analysis of approaches to planning development in four postsecondary education systems. Other studies that fell into the comparative category included Sadighian's (1975) study of university goals and governance in North America and Iran, and Mainali's (1985) study of organizational structures in two different cultural contexts.

Causal-comparative studies. Ex post facto or causal-comparative studies involved the use of *naturally-occurring experiments* in which groups were selected because they differed in some characteristic, and an attempt was then made to identify factors that might account for the difference. A relatively small number of studies have been conducted that clearly fell into this category.

In a study of the relationships among leader behavior, staff morale, and productivity, Keeler (1961) assigned a productivity score to each of 179 schools based on the results of grade 9 examinations from which the effects of pupil intelligence test scores had been partialled out. He then selected 23 schools that were above the mean on productivity and 23 schools below the mean as the sample for examining the relationships that were of interest. A similar strategy was used by Bevan (1970) in selecting two high schools that were rated at the extremes among nine schools on openness of climate in a study of the need for independence in high school students. A third example of a causal-comparative strategy is the study by Sullivan (1987) of variables related to high school achievement. The researcher selected samples of 48 graduates and 42 dropouts in one school district and then explored differen-

ces between the two groups on students' home environment, personal characteristics, academic performance, and school life experiences.

Experimental studies. In an experimental study the researcher engaged in the intentional and controlled manipulation of variables to test for a cause-effect relationship. A number of theses have been completed that have the characteristics of experimental studies; others are a closer approximation of quasi-experimental in that the random selection to treatment groups was absent.

In the first experimental study conducted by a doctoral candidate, Brown (1961) examined the differential effect of stress-inducing supervision on student teachers. Berghofer (1972) used three groups of graduate students to test the effects of different levels of exposure to literature in the area of futures research on the development of educational policy. Graduate students were also used by Plaxton (1969) to study the effects of different decision rules on interaction in small groups. Batchler (1977) involved workshop participants in a simulation to study the relationship between organizational climate and administrative behavior.

Panel studies. Panel strategies involve collecting data from the same set of individuals at different points in time. The closest approximation to panel studies in the theses reviewed were Delphi studies. In these studies, participants who are expert or knowledgeable in an area were asked to assess the probability, feasibility, or desirability of future trends or developments. Members of the panel then participated in successive rounds of data collection in which results from the preceding round were made available to the respondents.

The first task of the researcher was to identify prospective panel members on the basis of some criteria. Barrington (1980) used a panel of 10 college presidents and seven government officials to assess the projected impact of environmental forces on community colleges. Other researchers have used the same basic strategy to identify appropriate respondents to study policy issues in specific areas.

Trends in research strategies. The percentage distributions of theses in Table 2 indicates that two major strategies might merit the designation of traditions: the survey and the case study. Together these strategies account for nearly 85% of all doctoral research, and when the case/survey strategies are included the proportion approaches 88%. Although making comparisons was part of the analysis in a number of studies, only about 3% placed a major emphasis on a comparative design. Together experimental and causal-comparative research strategies were used in only 10 theses, while five involved data collection from a panel. The "other" category included simulations, computer modeling, information systems, and semiotic analysis.

Trends over the three decades reveal a decline in the proportion of surveys and an increase in the proportion of case studies. Surveys accounted for approximately 70% of studies completed in the first decade and just under 50% of those completed in the second and third decades. Case studies increased from around one fifth in the first decade to more than one third in the most recent decade.

Table 2
Percentage Distribution of Theses by Research Strategy

Research Strategy	1958- 1970 N = 74	1971- 1980 N = 112	1981- 1990 N = 133	Total N = 319
Survey	71.6%	48.2%	48.9%	53.9%
Case	20.3	31.2	35.3	30.4
Case/Survey	1.4	5.4	4.5	4.1
Comparative	0	5.4	3.8	3.4
Experimental	2.7	4.5	0	2.2
Panel	0	0.9	3.8	1.9
Causal-Comparative	2.7	0	0.8	0.9
Other	1.4	4.5	3.0	3.1

Analysis not reported in the table revealed that case studies that did not have an explicit historical dimension increased across the three decades. Studies that partially had a historical dimension decreased between the first and second decade and recovered only slightly in the third decade. In contrast, those that had a strong and explicit historical dimension increased from the first to the second decade and decreased slightly in the third.

Data Collection Methods

Although research methods could be described broadly in terms of such categories as quantitative and qualitative, a more precise description can be obtained from a consideration of the major methods of data collection or sources of data. For the types of studies carried out by doctoral candidates, data collection involved five main methods or sources that were used either singly or in combination: questionnaires, interviews, documents, observations, and records.

Questionnaires. As used here, the term questionnaire includes both various published or standardized instruments as well as those designed by the researcher. The number of researchers who designed their own questionnaires was considerably greater than those who modified available instruments or used published instruments.

The published instruments that have been used include a range of tests or scales of a primarily attitudinal nature. Among these are the Rokeach Dogmatism Scale, Edwards Personal Preference Schedule, Differential Values Inventory, the Kluckhohn value scale, and the Maslach Burnout Inventory. Researchers have also used instruments more closely associated with studies in administration such as the Leader Behavior Description Questionnaire, the Organizational Climate Description Questionnaire, and the measures associated with Fiedler's leadership theory. Although some of these instruments have tended to be overused in the field generally, this was not the case in relation to this particular set of studies.

Instruments that were adapted to the educational setting resulted in the development of a number of lines of research. For example, MacKay's (1964) adaptation of Hall's Organizational Inventory was used later by other researchers such as Robinson (1966), Kolesar (1967) and Richert (1968). The adaptation of Corwin's Professional Role Orientation scale developed by Hrynyk (1966) was also used subsequently by a number of researchers (Masse, 1969; Nixon, 1975; Scharf, 1967). Such lines of research have seldom resulted in the systematic and cumulative analysis of the merits of the instruments involved.

Interviews. The interview was used in a variety of ways ranging from being the primary source of data to being supplementary to other methods of data collection. Regardless of their general place in the research design, interviews varied in degree of structure from relatively highly structured to unstructured. Among the more highly structured forms of interviews were those associated with the Aston methodology for developing measures of the structure of organizations which was used by Newberry (1971), Heron (1972), Kelsey (1973), Sackney (1976) and Rourke (1983). Other researchers described their interviews as either structured, semistructured or relatively unstructured. The majority of interviews fell into the semistructured area in that the researcher usually had an interview guide or schedule but remained flexible, allowing the questions to shift in sequence. Relatively few researchers regarded their approach as being highly unstructured.

Observations. As a method of data collection, observation has taken a variety of forms. Like interviews, observations included both structured observation and those in which there was no predetermined basis for categorizing the observations.

Both direct and indirect forms of observation were used in structured approaches. As examples of direct observation, Mathews (1967) personally observed school board meetings and used interaction analysis to code the process. Similarly, Hemphill (1968) used the same coding methods but involved two trained coders to collect data on school board meetings. In contrast, Plaxton (1969) videotaped group sessions and then analyzed the interaction. Both direct observations and analyses of videotapes were used in studies of teaching and learning processes (King, 1979; Mireau, 1980; Wodlinger, 1980). Some researchers (Allan, 1985; Cooper, 1986; Duignan, 1979) used structured observation techniques—coding within predetermined categories—to analyze the work of administrators. In contrast to this approach, Moylan (1988) used more varied methods, as did Bird (1982) and Hall (1989) to study particular individuals.

In using observational strategies, researchers have defined varying participant roles for themselves in order to carry out studies in a variety of sites. A number of researchers have used observation in the form of attendance at meetings or becoming involved in other activities. Others were actual participants in the events that were the focus of their research. In such instances observation may have been a supplementary rather than a major aspect of data collection.

Documents. Documents as data sources included a broad range of written or printed materials that were relevant to a particular subject. Examples of

the types of documents that have served as primary and secondary sources are listed below:

- official files, reports, transcripts of proceedings, records of parliamentary debates, minutes, archives;
- legal documents such as laws and by-laws, acts of governments, law reports, statutes, records of court cases;
- correspondence, letters, briefs, memoranda;
- newspaper articles, newsletters, bulletins, periodicals ;
- policy documents, reports, historical documents; and,
- literature on a particular theme, major writings of theorists of interest.

Documentary sources were subjected to an appropriate form of content analysis to extract the data relevant to the research problem.

Records. For purposes of this classification, *records* was defined in the narrow sense to refer to data sources that are primarily quantitative in nature and that have an official or authoritative character. The following are among the types of records that have been used as data sources:

- student achievement data, student information files, cumulative records;
- statistical records such as earnings of various job classifications, census data, and vital statistics;
- annual reports of government departments, operational reports submitted by school districts; and,
- audited financial statements.

Data extracted from records were analyzed by a variety of descriptive techniques or involved inferential analysis.

Trends in use of methods/sources. The extent to which questionnaires, interviews, observations, documents, and records were used in data collection across the 319 theses is indicated by the percentage distributions in Table 3.

Nearly 60% of the research projects involved data collection by questionnaires followed closely by interviews that were used in about 56% of the theses and by documents that were data sources in about 38% of the studies.

Table 3
Percentage of Use of Data Collection Methods or Sources

Method or Source	1958- 1970 N = 74	1971- 1980 N = 112	1981- 1990 N = 133	Total N = 319
Questionnaires	67.6%	59.8%	53.4%	58.9%
Interviews	27.0	54.5	72.9	55.8
Documents	31.1	37.5	42.9	38.2
Observations	4.1	15.2	19.5	14.4
Records	20.3	9.8	9.8	12.2

Note: Sums of columns exceed 100% because of use of multiple methods.

Both observations and records were used in relatively small proportions of the theses, about 14% and 12% respectively.

A comparison of the proportion of research projects that used particular methods indicates changes across the three decades. The extent to which questionnaires were involved in data collection declined from being used in more than two thirds of theses in the first decade to just over one half in the third decade. Although relatively small, the proportion of studies involving use of records also declined. In contrast, the use of interviews increased from slightly more than one fourth of theses to nearly three fourths. Observations also increased dramatically as sources of data, while the use of documents increased from just over 30% of theses to about 43%. In general, the trends indicate a fairly dramatic shift from quantitative to qualitative methods across the three decades.

The extent to which multiple methods of data collection were used is indicated by the data in Table 4. About 42% of the studies used a single method of data collection while about 38% used two methods. Nearly 19% used three methods, and only a small proportion of research projects involved more than three methods of data collection. Over the three decades, the proportion of studies using only a single method of data collection was halved, from about 63% to 31%. In contrast the number of studies involving two methods almost doubled from 23% to 42%. Although fewer studies used three methods, the increase was proportionately about the same.

The particular method or combination of methods used by the 319 researchers is indicated in Table 5. Eighty-five of the 134 studies that used only a single method involved questionnaires, while documents and records were the single data source in each of 20 studies. Eight studies used interviews exclusively, and only one used observation exclusively. The decline in the use of questionnaires over the three decades noted previously is also evident in this table.

The two most frequently occurring combination of methods were interviews/questionnaires and documents/interviews, each of which comprised about 15% of the studies. The next most frequently occurring combinations were documents/interviews/questionnaires and documents/interviews/observation representing about 8% and about 6% of the studies respectively. Various other combinations occurred but in total represent only about 14% of all studies.

Table 4
Percentage Distribution of Theses by Number of Methods

Number of Methods	1958- 1970 N = 74	1971- 1980 N = 112	1981- 1990 N = 133	Total N = 319
One	63.5%	41.1%	30.8%	42.0%
Two	23.0	42.9	42.1	37.9
Three	13.5	14.3	24.8	18.5
Four	0	1.8	2.3	1.6

Table 5
Distribution of Theses by Data Collection Method

Method	1958- 1970	1971- 1980	1981- 1990	Total
Questionnaires	32	29	24	85
Documents	7	8	5	20
Records	8	7	5	20
Interviews	0	1	7	8
Observations	0	1	0	1
Interview/Questionnaire	4	18	27	49
Document/Interview	6	20	22	48
Document/Interview/Questionnaire	7	8	11	26
Document/Interview/Observation	0	3	15	18
Interview/Observation	1	4	4	9
Interview/Questionnaire/Records	1	3	3	7
Questionnaire/Records	4	1	1	6
Observation/Questionnaire	1	4	0	5
Document/Interview/Observation/Quest.	0	2	3	5
Interview/Observation/Questionnaire	0	2	1	3
Interview/Observation/Records	0	0	3	3
Documents/Observation	0	1	0	1
Documents/Records	1	0	0	1
Interview/Records	0	0	1	1
Documents/Interviews/Records	1	0	0	1
Document//Observation/Questionnaire	1	0	0	1
Documents/Questionnaire	0	0	1	1
Total	74	112	133	319

Purpose, Strategy, and Method

Further insights into the characteristics of research in general and trends over time may be obtained by combining the different bases of classification. This was done by focusing on purpose and research strategy. To simplify the presentation, the description is restricted to major categories or types of studies.

When a cross classification of purpose and strategy was developed, four major types were evident: descriptive case studies, descriptive surveys, descriptive/relational surveys, and relational surveys. Nearly three fourths of the 319 theses could be placed into one of these four types. Approximately 26% of all theses were descriptive case studies and another 18% were descriptive/relational surveys. Descriptive surveys and relational surveys accounted for about 16% and 12% respectively of the studies.

Table 6
Percentage Distribution of Theses by Type Based on Purpose/Strategy

Type	1958- 1970 N = 74	1971- 1980 N = 112	1981- 1990 N = 133	Total N = 319
Descriptive Case	20.3%	24.1%	30.8%	26.0%
Descriptive/Relational Survey	29.7	15.2	15.0	18.5
Descriptive Survey	12.2	13.4	19.5	15.7
Relational Survey	21.6	12.5	7.5	12.5
Other	16.2	34.8	27.1	27.3

Descriptive case studies increased in each decade from about 20% through 24% to 31% as proportions of all studies. A similar trend—12% to 13% and then to 20%—is evident for descriptive surveys. In contrast, descriptive/relational surveys declined from about 30% to 15%. Even more dramatic was the decline of relational surveys from 22% to less than 8% of all studies. Of interest also is the high proportion of studies, nearly 35%, in the “other” category during the second decade.

Research Topics

Because there is no consensus about the boundaries or major subdivisions of the field, any basis for categorizing theses in terms of the substantive focus is likely to appear to be somewhat arbitrary. The categories and subcategories for organizing the substantive review emerged as the result of a lengthy process of sorting, classifying, and regrouping abstracts of the studies. Among the underlying objectives in the procedure was the desire to present as unified a perspective on the research as possible, to be parsimonious in the topics used, and, at the same time, to represent adequately the diversity of the research areas. Inevitably, the major research topics identified reflect a particular view of the subdivisions in the study of educational administration.

Through the process that was adopted, seven major topics were identified: individual and organization, organizational analysis, policy development and implementation, educational and organizational change, the context of educational administration, decision making, and the administrator and administration. As might be anticipated, some arbitrary decisions were necessary in this process. Certain studies could easily be placed in any one of a number of categories, while other topics tested the limits of the framework. To have done justice to the uniqueness of the individual theses would have necessitated a much more extensive list of topics and subtopics.

An indication of the general substantive emphasis in the research is provided by the data in Table 7. The general topic that was labeled *individual and organization* encompassed the largest proportion of studies, approximately one fifth. About one sixth of the studies related to each of two topics: organizational analysis and policy studies. The other topics in order of decreasing emphasis were educational and organizational change, the con-

Table 7
Percentage Distribution of Theses by Topic

Topic	1958- 1970 N=74	1971- 1980 N=112	1981- 1990 N=133	Total N=319
Individual and Organization	14.9%	17.9%	24.1%	19.7%
Organizational Analysis	18.9	18.8	14.3	16.9
Policy Development and Implementation	5.4	21.4	19.5	16.9
Educational and Organizational Change	9.5	14.3	16.5	14.1
Context of Educational Administration	23.0	11.6	7.5	12.5
Decision Making	16.2	10.7	8.3	11.0
Administrators and Administration	12.2	5.4	9.8	8.8

text of education, decision making, and the administrator. The latter category included fewer than one tenth of all studies.

Some changes in substantive emphasis are evident over the three decades. Most dramatic is the consistent decrease in the proportion of studies that relate to the context of education—from more than one fifth of the studies in the first decade to about one twelfth in the most recent decade. A similar trend is evident in research related to decision making. The focus on the administrator decreased from the first to the second decade but moved upward in the third decade. Research in the general area of organizational analysis remained steady over the first two decades but declined slightly as a proportion of studies in the third. The remaining three topics—individual and organization, policy development and implementation, and educational and organizational change—all show increases as a proportion of studies from the first to the third decade. The most dramatic change was in the area of policy development and implementation, which accounted for only about 5% of the studies in the first decade but approximately 20% in the second and third. Research into change and into the individual and the organization also increased steadily, as proportions of total studies, across the three decades.

Discussion

Various aspects of the doctoral research warrant some comment; however, the discussion in this paper is restricted to the emphasis and the trends in the research.

Research Emphasis

Although there is a measure of diversity along various dimensions, doctoral theses in educational administration seem to be dominated by two major models of research. The first model supports studies that focus on relationships among variables, use survey strategies, rely on questionnaire methods of data collection, and subject the data to quantitative analysis. The second model promotes studies that describe a particular area of interest or series of events, involve case study strategies, use documentary and interview data sources, and analyze the data through nonquantitative methods. Some of the

variations in the research reflect a blending of certain features of the two models such as using surveys to generate descriptions or supplementing questionnaire data in relational studies with interview and documentary data. The pervasiveness of these models probably reflects to a considerable degree the constraints under which doctoral research is conducted as well as the state of research in the field of study generally.

Given the nature and state of studies in educational administration, some questions might be raised about the merits of the type of research that has been conducted. An interest in describing phenomena may be appropriate for a relatively new field of study, especially one that is closely associated with an area of professional practice. Similarly, examining relationships among variables may reflect a need to conform to a particular conception of "scientific" research in order to establish and maintain academic credibility. However, the limited number of conceptual or methodological studies seems inconsistent with the needs of a developing area of research. Furthermore, the degree of effort that has been directed toward evaluating practices or developing alternatives does not address adequately the needs in the field of practice. If research in educational administration were oriented more toward improving practice, then the evaluation of existing programs or policies would seem to be an appropriate focus for more doctoral studies. A similar statement might be made about developmental research; more attention might be directed toward developing ideas or innovations that have administrative or educational application.

In spite of recent debates about quantitative and qualitative methods, the characteristics of thesis research suggest that researchers have used both methods extensively and that the two methods have been combined in various studies. The acceptability of, and apparent success with, these different methods may reflect both eclecticism and pragmatism. Researchers who have combined both quantitative and qualitative methods may have avoided addressing some of the more fundamental issues that have been the focus of debates. Different methods of data collection probably were combined within the same philosophical perspective. The tendency to use both quantitative and qualitative methods may be indicative both of allowing the problem to determine the methods of data collection, as well as of an interest in developing more comprehensive descriptions.

An examination of the types of studies conducted in each of the three decades suggests a process of change in approaches to doing research. Significant among these changes is a shift away from relational studies to more descriptive studies, from surveys to case studies, from questionnaires to interviews and documents as data sources, and from single to multiple methods of data collection. These specific changes may be indicative of a significant shift in basic conceptions about the nature of research appropriate for a field such as educational administration. A fairly narrow conception of research may be giving way to broader definitions and alternative conceptions. There is increasing variety in research strategies and methods; established approaches are not disappearing entirely but instead are being supplemented by other strategies. In these developments, the emergence of

an interpretive or hermeneutic orientation such as in Evans' (1989) study may prove to be of particular significance.

Research Trends

In recent years, different orientations in research have sometimes been conceptualized in terms of the notion of alternative paradigms. Similarly, changes in orientations over time have been discussed from the perspective of paradigm shifts. Although variations in approaches to doctoral research in educational administration may not warrant the designation of paradigms, the broader debate prompts questions about the nature of underlying differences and trends. A consideration of the variations in the theses that have been reviewed suggests that they might be differentiated on the basis of three broad clusters of characteristics. The clusters of characteristics reflect different emphases in basic purpose, research strategy, methodology, and stance of the researcher as well as in substantive focus. For the purposes of this discussion, these clusters of characteristics will be referred to as *types* within a loose definition of the term. The types are specific to the theses that have been reviewed and are not proposed as being descriptive of the nature of research in the broader context.

The first type of doctoral study (Type A) is based on questions that have considerable practical import. Studies of this type promise outcomes that have practical or social relevance. More specifically, the research problems draw significance from the world of administrative practice. The purposes of the research project are presented in a form that suggests a descriptive or perhaps a relational study. Research strategies are likely to be surveys or case studies with appropriate reliance on either quantitative or qualitative methods of data collection. Implicitly, the researcher adopts the stance of an objective observer or analyst who will provide knowledge that has potential to increase understanding of a problem and possibly to offer some means for resolving the problem. In general, Type A studies reflect the needs of a field of practice and probably are consistent with the characteristics of the earliest orientation to research in educational administration.

A second type of study (Type B) is associated closely with what has come to be known as the theory movement. Essentially, the research problems investigated have both theoretical and practical significance. If the problem originates in the field of practice, then it is cast in a theoretical framework. Alternatively, the research problem may originate within a theoretical formulation, and the practical aspects may be but one instance of a class of similar problems. The purpose of the research may involve testing a particular line of theorizing or establishing the basis for developing a new conceptualization. Any one of a broad range of research strategies—case studies, surveys, quasi-experimental designs, and others—may be used. Implicitly, the general stance of the researcher is that of a “scientist” who is capable of contributing objective, conceptually based, and empirically verified knowledge to the study of educational administration.

The third type of study (Type C) may be viewed, in part, as a reaction to Type B research. Although based in the social and human sciences, the definition of science is much broader. The essential difference from Type B

research involves developing understandings more from the perspective of the participant than from that of an objective observer. There is some resemblance to Type A research in that the research is descriptive, but the nature of the understanding sought is different. The research strategies are more likely to be case studies or multi-case studies using a variety of field research techniques. Essentially, the data collection methods are qualitative while the methods of analysis tend to be interpretive.

All three types of research are evident in the doctoral studies that were reviewed; however, the boundaries are not as sharply delineated as the definitions would seem to indicate. There is a considerable degree of overlap and blending of the types. Given this overlap, attempts to place individual studies into particular types would lead to distortions. Nevertheless, conceptualizing the research in terms of these three types offers a basis for describing the changes in emphasis over the three decades.

Some of the research initiated in the early years of the Department reflects Type A characteristics. Studies that resemble Type B research gained prominence in the 1960s and 1970s. Type C studies emerged primarily in the 1980s and represent an increasing proportion of doctoral research. Nevertheless, examples of all three types are evident in recent years, indicating the presence of pluralism in research orientations.

Of particular interest is the presence of studies that combine the characteristics of two or all three types. For example, some studies that have most of the characteristics of Type A research may also reflect the conceptual orientation and methods of Type B research even though these may not be essential to achieving the purposes of the study. Similarly, Type C research may show some characteristics that resemble those of Type B research. A specific illustration is the use of established approaches for determining validity and reliability even though these may be inconsistent with the basic assumptions.

The emergence of Type C studies was preceded by some “erosion” in the canons of Type B research. The fairly systematic approaches involving explicit theorizing and hypothesis testing evident in earlier studies subsequently declined. In particular, an increasing number of studies lacked an explicit theoretical base, and hypotheses were replaced by research questions. Similar to the earlier influences of Type B on Type A research, Type C has also had an influence on Type B studies. This has generally taken the form of adding a qualitative dimension—using open-ended questions and supplementing questionnaire data with interviews or document analysis—to strategies that previously were primarily quantitative.

An interpretation in terms of these types of research suggest that an evolution metaphor is appropriate for understanding the development of doctoral research in educational administration. As new clusters of strategies emerge, they serve to modify existing approaches and, consequently, change the overall character of the research without replacing totally the previous strategies, at least not in the short term. Whether emerging emphases will eventually change the fundamental nature of the research remains to be seen.

The discussion of trends in terms of these types suggests the possibility of other types. For example, to date there is no clear evidence in doctoral studies of research based on a critical analysis of the practice of educational administration or of educational policies. However, there are some indications that such an orientation might emerge from an increased concern, as in Maynes' (1990) study, with the substantive aspects of policy issues and not just the processes through which the issues might be resolved.

Conclusion

Research conducted by graduate students in fulfillment of degree requirements constitutes a major part of the total research effort in the study of educational administration. Within the graduate research area, doctoral studies in particular have potential for making a significant contribution to the further development of the field. Although some doctoral research is published, many of the studies do not attain the necessary degree of visibility to ensure that they come to the attention of other researchers. As a consequence, the full potential of doctoral research is seldom realized. A review of the doctoral theses completed in one department tends to confirm the desirability of carrying individual studies through to publication as well as of allocating resources to synthesizing and critiquing studies. Among the possible benefits of such activity would be a sharper focus on important topics, increased conceptual and methodological rigor, and reduced fragmentation of research activity. Clearly, cooperative and collaborative activities across departments in different universities would ensure even greater returns on the investment in graduate students and in graduate student research.

In addition to contributing to knowledge in specific areas, collectively doctoral studies offer a perspective on the general nature of educational administration research. When viewed over time, doctoral theses offer insights into the development of the field of study. The perspective reveals that while there are some "traditions," the field of study is also dynamic. Collectively, researchers appear to be engaging in a search for ways in which the study of educational administration can contribute to improving administrative practices and to linking those practices to the attainment of desired educational goals. Emerging pluralistic and self-critical orientations promise progress in the continuing development of research in educational administration.

Note

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A Note on History, Educational Policy, and the Uses of the Past¹

The purpose of this paper is to examine how the historian's values inform the history of educational policy. The problem is explored with reference to Kuhn's understanding of value judgment and theory choice. When applied to a case study of policy-oriented history, these understandings suggest that Kuhn's analysis functions as a heuristic device in assessing the normative dimensions of historical research.

When Santayana (1905) remarked that "those who cannot remember the past are condemned to repeat it" (p. 284), he voiced a concern about the value of history that has engaged the minds of historians since antiquity. Santayana's observation has a special significance for the study of policy, especially when it turns to history to illuminate and inform decision making in education. Although historians have shown exceptional skill in analyzing the dynamics of political and social change in the development of educational policy (Hansot & Tyack, 1982; Silver, 1983, 1990; Warren, 1983), few have stepped back in this process to examine the centrality of values that, as Carr (1987) suggests, prompt not only the questions that historians ask, but the answers they receive (Novick, 1988, pp. 522-572). Such values dominate the historian's analysis of educational policy and as standards or principles of worth set the agenda for the methodological concerns which arise (Fischer, 1980, pp. 19-65; Kaplan, 1964, p. 370). The purpose of this article is to examine how the interpretation of historical events and the values on which it is based inform our knowledge of decision making in education.

The implications of this problem for policy historians can be explored from any number of perspectives, but one of particular interest follows from Kuhn's idea of the paradigm (1970a, 1970b, 1977). When broadly defined, the paradigm may be understood as a conceptual framework or theory that represents the accepted beliefs and traditions held by members of the scientific community (1970a, p. 250). The viability of this concept for the study of history is echoed in Hollinger's (1985) observation that Kuhn's idea of science "speaks to, and for historians as few works of *philosophy* of history ever have" (p. 105; compare with Fischer, 1970, pp. 161-170). Hollinger's remark, when directed to the normative foundations of historical research, suggests new possibilities for clarifying the nature of history as policy analysis.

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In exploring this hypothesis, I first examine the idea of the paradigm and its significance for historical knowledge, noting in particular the nature of value judgments within the paradigm. Then I investigate the implications of that relationship for policy analysis, using as an illustrative sketch Cubberley's instructive yet controversial approach to the history of education. The argument concludes with a critical assessment of the paradigm as a heuristic device for the study of values in history as policy analysis. How, then, do values influence our interpretation of the past and, in turn, affect our understanding of educational policy?

Paradigms, Values, and History

The significance of values for the study of policy-oriented history might be assessed in relation to Kuhn's understanding of the paradigm. For Kuhn, there are two basic meanings of the term. In one sense it represents the disciplinary matrix or "the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community" (Kuhn, 1970b, p. 175). Included in this understanding are the community's metaphors, symbolic generalizations, and shared commitments. The second and more specific meaning of paradigm is contained within the first and refers to the accepted models or examples that replace the community's explicit rules in the cumulative process of normal enquiry (Kuhn, 1970a, p. 250). Such models, articulated and described within the periodical literature, show members of the community how their research is to be done. They result in a "tacit knowledge" for others in the tradition seeking a solution to similar problems in the field (Kuhn, 1970b, p. 192). Over time the emergence and accumulation of problems that cannot be explained by the usual exemplars may lead to paradigm change and the development of a new tradition (1970b, p. 204).

Within the paradigm values are of particular importance. They are widely shared by members of the community and, in the process of application, influence the choices that they make (Kuhn, 1977, p. 335). For Kuhn, values emerge in the community's problem solving activities, reflecting what might be identified as the group's ideology (Kuhn, 1970a, p. 241). They are, in addition, a largely "unconscious concomitant" of theory choice in the preference of one explanation over another (Kuhn, 1977, p. 336). Although members of the community may share a set of common values, they may differ in their application. "In those situations where values must be applied," Kuhn remarks, "different values, taken alone, would often dictate different choices" (Kuhn, 1970b, p. 185; compare with Carr, 1987, p. 131). The distinction between values and their application within a paradigm is critical to the explanation of events, for "knowing what scientists value, we may hope to understand what problems they will undertake and what choices they will make in particular circumstances of conflict" (Kuhn, 1977, p. 290). Values, then, are integral to the community's tradition and evolve with it (p. 335). As Kuhn observes, they are theory-bound to the paradigm and hence tied to its "cognitive commitments" represented in the terms, phrases, and sentences of the language used by individuals (p. xxi). In this context the paradigm provides the researcher not only with a map, but in relation to the

applied values by which in part it is defined, "some of the directions essential for map-making" (Kuhn 1970b, p. 109; compare with Olafson, 1979, pp. 259-260).

In historical research paradigms as models or exemplars would not be limited in time to a specific cultural-historical period. A range of competing research traditions might coexist with no one enjoying the unequivocal support of all members in the historical community. The paradigm, therefore, does not function as a set pattern of history defined, in Fischer's words, as "a right-or-left-handed spiral, a sine curve, a merry-go-round or a loop-the-loop" (1970, p. 162). It serves primarily as a "flexible empirical device," a methodological postulate helpful in unmasking the structural reformations in historical events.

From this perspective values emerge on two different although not mutually exclusive levels. On one level they are critical to the historian as historian who holds an allegiance to certain values in the light of accepted canons of historical research; while on the other they are central to the historian as analyst who clarifies the conditions surrounding the intention, implementation, and outcome of decision making in education. Their impact on one level, however, is not independent of the other, since values as principles of worth might be viewed as instrumental to further ends (Kaplan, 1964, pp. 393-395). Put in another way, the historian's analysis of educational decision making, that description and explanation of policy-related events, is based not only on the shared ideals or inherent values of historical research, but in the choices which individual historians make. These choices reflect operative or applied values, a normative condition of "values in use" that are part of a means-end, value-oriented continuum (Berkhofer, 1969, pp. 101-107, 124-129).

Of the values shared by the community of educational historians two are of particular importance since they speak directly to history as policy analysis. The first embodies a belief in the value of education and schooling. However it may be expressed, historians of education share this value as part of the community in which they exist. The second accepts the reasoned search for truth in the explanation of historical events. Among others, these values as standards or principles of worth command the assent of virtually all historians of education regardless of their association with either traditional or revisionist schools of historical thought.

When applied in the context of a given paradigm, such values assume a specific meaning with their inherent worth becoming instrumental to the pursuit of particular ends (Kaplan, 1964, p. 393; compare with Hodysh, 1989). The shared value, say, of education may be identified with the concept of schooling or, perhaps, enculturation; whereas reasoned explanation may be associated with dialectic, evolutionary, or possibly functionalist approaches to the interpretation of events. As a cognitive commitment, the translation of values from their inherent to instrumental worth is both functional and contextual (Kaplan 1964, p. 395). This in no way detracts from the expectation for the historian to provide a detailed and balanced account of educational policy in the setting where it occurred, but rather

within that understanding affirms the importance of values as an implicit if not an explicit feature of historical research.

Educational Policy and Historical Knowledge: A Case Study

The influence of value judgments on policy-oriented history might be explored with reference to Cubberley's *Public Education in the United States* (1962), a work whose approach to the values of education and reasoned inquiry has special significance for historians of education (compare with Friedman, 1965; Hodysh, 1984; and Lewis, 1967). The book, which significantly shaped the development of educational historiography as a field of study, may not be a policy analysis in the conventional sense, lacking perhaps the specific focus on multiple causation and a detailed concern with the effects of power and the evolving structure of educational policy indicative of more recent studies (Stearns, 1984, p. 110; Warren, 1983, p. 159); yet it presents an assessment of historical change that makes a policy-related contribution by exploring the impact of social and political forces on educational decision making. The central theme of this pioneering history was "the progressive evolution of the power of the state to standardize public schooling, a tale of reformist battles won and further professional goals to accomplish" (Tyack, James, & Benavot, 1987, p. 13). It might be argued that Cubberley's *Public Education* was among the first comprehensive histories that, in the light of a changing America, addressed policy-type questions about education and government in the context of a wider historiographic tradition.

The Emergence of Tradition

Although Cubberley's approach to educational history has been traced to events in the latter part of the 19th century, its definition was primarily a result of developments that for Cubberley occurred at Stanford University about the turn of the century (Cohen, 1976; Cremin, 1965). His influence, along with that of Paul Monroe at Columbia, "the nation's leading historian of education" (Cohen, 1976, p. 306), contributed to the development of educational history as a field of study in teachers' colleges and departments of education. How this was achieved and the problems that were confronted in the process became the basis for a community of educational historians, many of whom shared a common historical and educational vision.

Both Monroe and Cubberley saw the nature and purpose of education in a particular way. Education in Monroe's *Cyclopedia* (Monroe & Kandel, 1912, p. 294) was regarded as the highest conscious effort of society, the culmination of a social process. This ideal, illustrated with reference to the pedagogical views of prominent orators and philosophers in the western educational tradition, covered a time frame from the classical period onward. A similar view appeared in Cubberley's (1920a) *The History of Education* where he emphasized "a history of the progress and practice of education itself" (p. viii). As Monroe remarked, education was an "institutional attempt to realize in individuals the ideals controlling a given people" (1906, p. vi), and this was to be achieved by the extension of universal schooling.

The cognitive commitments of Monroe and Cubberley were represented in a shared vocabulary evident in the use of concepts such as "social evolu-

tion” and “progress.” In *A Text-Book in the History of Education*, Monroe (1905) claimed that the application of an evolutionary direction yields new insights into the work of educational theorists from primitive to modern times. It assists the student in establishing a conception of the meaning, nature, process, and purpose of education that “will lift him above the narrow prejudices, the restricted outlook, the failures and the petty trials of the average schoolroom, and afford him the fundamentals of an evolutionary faith as broad as human nature and as deep as the life of the race” (p. ix). There is an alignment of the interests of the school with “social efficiency” and the belief that historical movements “characteristic of the past ... are working themselves out” in the tendencies of the present (p. 751). Such history, closely related to social and political developments, affirms “the spread of western civilization and the state-school idea over the world” (Cubberley, 1920b, p. viii).

Policy-Oriented History

Cubberley (1962) begins his *Public Education* with prefatory remarks about the educational problems of the day and their connection to the recent past. In expanding the thesis developed in his earlier *Changing Conceptions of Education* (1909, p. viii), Cubberley (1962) examines the impact of political institutions and social forces, presenting, as Stearns (1984) would suggest, a procession of events rather than a sustained historical analysis of organizational context and policy precedents (pp. 99-100). Cubberley’s *Public Education*, nevertheless, contributes to an understanding of educational policy in describing and explaining, say, the influence of government and society affecting the development and outcome of curriculum change.

A central feature of policy analysis evident in *Public Education* is the explanation of political processes underlying the attention of government and society to education (Silver, 1983, p. 250). To some extent this concern is addressed where, among other examples, Cubberley examines the “struggle” of Horace Mann against the forces for sectarian control of education (1962, p. 298), the impact of the Cousin Report on centralized state educational control (pp. 257-258) and later the efforts of the federal government to establish a Commissioner of Education (pp. 739-740). Current histories of educational policy, however, more fully explore a wide range of variables and multiple causes for historical phenomena, including ideas of state, legislation, power, and their significance for knowledge, social values, and the conditions of learning and achievement (Silver, 1983, p. 250). Although Cubberley’s approach to these phenomena lacks in-depth analysis, it reflects the wider implications of government involvement in education evident in his discussion of illiteracy in adult education and the effects of legislation both on industry and child-labor regulations (1962, pp. 570 ff.).

Cubberley’s (1962) history ends with a comment on existing challenges in education, including among his topics the influence of child health and welfare developments, new directions for educational change, equality of educational opportunity, and the implications of administrative and professional reorganization. Interestingly, he cites the failure of the individual states to have followed for any length of time “a well-thought-out educational

policy,” noting that “a conception of the State as an active and energetic agent for the improvement of educational conditions and the advancement of public welfare has been entirely lacking” (pp. 732-733).

Implications for Analysis

Whether Cubberley’s (1962) *Public Education* is viewed as an early form of policy analysis or an educational history that touches on policy problems, it would seem that the function of government in education is among its central concerns. Cubberley’s argument, framed on the assumption that social progress is achieved through state control, is grounded in part on normative understandings of education and historical change. As an inherent value, education is defined by the extension of institutional schooling. This process includes not only a linear sequence of development from elementary education onward, but reference to a wider involvement of universities, normal schools, and library and agricultural extension (p. 590; compare with Ward, 1987, pp. 469-472).

Within this paradigmatic framework, Cubberley (1962) establishes the beginning of early education in colonial schools. These origins serve as the basis for an awakening of “educational consciousness” and the eventual triumph of public education in the nation. Concepts of state and legislation at both local and federal levels focus the relationship between education and government in the emergence of decision making. More specifically, the intention and implementation of educational change is described and explained in relation to significant individuals as well as to legislation. Reference, for example, is made to Robert Breckenridge in his efforts to secure public funding for education in the state legislature of Kentucky in the mid-1800s (pp. 187-188). The outcome of decision making is also noted in Cubberley’s analysis of curriculum reform as it affected the appearance of the junior high school in California in the early 1900s (p. 555). These problems of policy are explained and articulated with the support of demographic and financial statistics, superintendent and commission reports, memoirs, and a variety of secondary source materials.

Reasoned inquiry as a shared value of historical research is evident in Cubberley’s explanation of educational change. This is achieved by means of the genetic or historic method, which contributes to an understanding of the shifting pattern of state educational policy. The method is used not only to establish the origin and sequence of educational development, but to compare educational conditions with what had come before. In tracing the course of events, Cubberley sets out to illustrate how “educational service in its proper setting as a great national institution” has helped to solve many of society’s problems (1962, p. viii), an assumption that directs the reasoned description and explanation of historical events to an instrumental end (Berkhofer, 1969, p. 107).

The genetic method influences historical analysis on two levels. The first includes the identification of stages or periods of development and is apparent in the continuity of large-scale change from colonial times to the present. The second level is represented in the small-scale study of government involvement, say, in legislation affecting the consolidation of school

districts in the late 1800s (Cubberley, 1962, pp. 721-727). In both instances, data assist the description and explanation of state control in schooling. Using this method, Cubberley establishes the roots of educational change and, in terms of government policy and direction, the “battles” and “struggles” to achieve social efficiency.

Many have argued, and perhaps rightly, that Cubberley’s assumptions of progress, social efficiency and state control are questionable, that his concepts, explanatory techniques, and data are selective and as a result contribute to an exaggerated presentism that has distorted the past. These objections, however, do not diminish the inherent values of education and rationality embedded in his work, but rather address the way in which those values are applied. This change from ideal to operative values is accomplished in Cubberley’s decision to consciously or otherwise adopt assumptions and concepts that are instrumental to particular ends. In appreciating the paradigm in which those values are framed, one perhaps might conclude that in knowing what Cubberley as a historian valued, one might hope to understand, but not necessarily approve, the choices that he made (Kuhn, 1977, p. 290).

This illustrative analysis, although limited to a single case study, suggests the following tentative observations:

1. The historian’s perception of the past and, therefore, the analysis of educational change is not conceptually neutral. It is structured by a model or a paradigm containing in part values and linguistic categories (Mommensen, 1978, p. 23).
2. These values, such as education and reasoned inquiry, are concurrent with the paradigm and in terms of their application interdependent with the cognitive commitments by which it is informed.
3. As a result, the historian as policy analyst is unable to escape a value-oriented epistemology that influences the criteria of truth and validity that the historian employs (Fischer, 1980, p. 25).
4. This implies that the historian’s analysis of educational policy and the conclusions that are drawn are unavoidably theory-bound.

History and Educational Policy: Problems and Prospects

The normative critique of policy-oriented history suggests that an understanding of the past and its possible use in educational decision making requires further analysis of the idea of the paradigm. This elusive concept, subjected to extensive discussion by historians and philosophers alike, has been found wanting, with one critic noting that Kuhn has used it in 22 different ways (Masterman, 1970). Kuhn’s attempt at clarification has led to the specific concept of the paradigm as model, a derivative of the generalized term and one that has proved useful in historical research.

It is evident, nevertheless, that difficulties in the use of the paradigm exist not only in relation to its internal components, but in terms of the idea of community. In the community of educational historians, it might be argued that the internecine disputes over the description and explanation of events represent little more than individual efforts to account for historical change. However, the differing approaches, reflecting a variety of paradigms and

ideas of power, may in combination strengthen rather than weaken the historian's understanding of educational policy. And further, whereas historians may disagree on the applied values and assumptions behind the description of policy intention and outcome, they share inherent ideals of education and reasoned inquiry that in part establish a common scholarly tradition.

An additional problem implies that the coincident relationship between the paradigm and its values permits a reductionist interpretation that could remove any meaning these terms might individually possess (Kuhn, 1977, p. 336). The possible resolution of this issue follows a realization that the paradigm as a shared inheritance embraces not only its ideal and applied values, but concepts and assumptions that delineate the paradigm's distinctive character and function. From this perspective values are defined in relation to their companion elements and, it would seem, not reducible to the paradigm as a whole—an awareness that may alert the historian to the particular contribution of those components to an understanding of continuity or change in the educational policy of the past (compare with Fischer, 1970, p. 161).

A final concern centers on the possibility of applying historical knowledge to the formation of present and, perhaps, future educational policy (Graham, 1980, p. 22). In this context the historian employs a process of analogical inference that includes more than an investigation of the origin and nature of decision making in education. Specifically, if values of historical research influence the interpretation of policy-oriented history, might a study of their effect in different historical paradigms contribute to a normative consensus useful in educational planning? This approach, focusing on the clarification of ideal and operative values, assumes that a comparative analysis of historical models might lead to a set of normative guidelines that could inform an educational course of action (Fischer, 1980, p. 49). The study of contrasting paradigms, however, prompts attention not only to problems of identifying similar or equivalent policy-related events from the past, but to the criteria used in selecting for analysis one value-laden model in preference to another.

These challenges, however appropriate, do not dislodge the importance of the paradigm as a heuristic device. They focus, after all, on the function of values in the existential events of the past and, more critically, in the structure of historical interpretation (Scott, 1979, pp. 12-17). In our search for perspective, they contribute to a dialogue within the historical community (Novick, 1988, pp. 626-628) and, in pursuit of policy-oriented research, a determination of its normative problems, if not their solutions. In this context the paradigm is not to be viewed as a rigid framework imposed on historical data from without, but rather, by means of analysis, as a clarification of what in the way of evidence is already there; yet regrettably, some historians have remained indifferent to such theoretical concern. They might agree, however, that many of Kuhn's insights are not foreign to their craft and are based on a knowledge of what their community has long taken for granted. With this understanding, perhaps it is time to reconsider the nature of value judgments and their place in the historical study of educational policy.

Note

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Myths and Assumptions of Literacy Education

There has been considerable debate over the past three decades regarding literacy education in the schools. In this article, selected issues are examined in relation to myths surrounding literacy to identify assumptions underlying these issues. From this examination, it is apparent that basic assumptions underlying literacy education have changed very little. Literacy has been and continues to be viewed as an individual achievement, as an educational phenomenon, and as closely linked to economic development and industry.

Introduction

There has been considerable debate over the past three decades regarding the teaching of reading and writing in the schools. As an active participant in some of this debate, I believed that the changes we were debating could have a significant impact on the quality of literacy education. The shift from reading readiness to emergent literacy seemed to have the potential to improve early literacy education for young children. The shift from a skills focus in reading and writing to a process orientation appeared to have even broader implications. However, after three decades of involvement in this debate both as a participant and spectator, the bottom line has changed very little. There are still significant numbers of children being labeled as failures in reading and writing in our schools.

Recently, my work in adult literacy has helped me to reexamine the nature of the debate regarding literacy and I have begun to suspect that while there appear to have been dramatic changes in literacy research and practice, the assumptions underlying literacy education have changed very little over the past three decades. One of the reasons for this involves the mythology surrounding literacy—myths that lead to panic and a corresponding search for panaceas to the “literacy problem.” In the first part of this paper, I attempt to expose two of these myths to provide a perspective for the second part, which focuses on the assumptions underlying selected issues in literacy education since the mid-’60s.

Two Literacy Myths

The two literacy myths discussed below are closely related. The first involves the contention that the illiteracy problem is much worse than many people think and is getting worse. The second involves the assumption that literacy

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development is both the cause and the solution to many social problems and will lead to economic development.

The Literacy Crisis

The words *crisis* or *epidemic* frequently appear in both the professional and popular literature on adult literacy. For example Kozol's (1985) book *Illiterate America* is highly alarmist, referring to illiteracy as a "growing crisis" and a "pedagogic time bomb." In Canada, Senator Joyce Fairbairn (1987) spoke in the senate about illiteracy as this country's "hidden shame" and "profound problem."

Two types of statistics are commonly used to support the crisis mentality. The first are statistics on the extent of illiteracy; the second involves estimates of the costs of illiteracy. In regard to the extent of the problem world-wide, Ryan (1985) noted that in 1985 there were 857 million people in the world who were illiterate and that a gradual growth in absolute numbers of illiterates is projected until at least 2000. While the absolute number is increasing, however, there has been and will continue to be a steady decrease in the percentage of the adult population that is illiterate.

The most commonly used statistics in Canada come from census data. The 1986 census data revealed that 3,393,725 persons or 17.3% of the Canadian population aged 15 and over had achieved less than grade 9 in school. In Alberta, the corresponding figures are 192,875 or 10.8% (Statistics Canada, 1989). Census data have frequently been criticized as an indication of literacy (French, 1987; Hunter & Harman, 1979) because it is obvious the "number of school years completed at some time in the past does not define the level of proficiency obtained at that time, nor does it in any way guarantee retention in adult life" (Hunter & Harman, 1979, p. 16). In 1987, Southam News attempted to determine the extent of illiteracy in Canada from a functional perspective. Borrowing items from the National Assessment of Education Progress used in the United States, Southam News drew a random sample of 2,398 persons from across all the provinces and administered both an interview to obtain background information and the functional literacy test. Overall, Southam estimated from their results that 4,502,000 adult Canadians (24%) are illiterate, but the Southam data are at least as problematic as those from the census. The relevance of some test items on the Southam survey have been questioned (Fagan, 1988; Olson, 1988) as have the cut-off point selected to discriminate literate from illiterate adults (Fagan, 1988) and the operational definition of literacy used in the study (Froese, 1988). Using a similar set of items to that in the Southam study, Statistics Canada conducted its own survey with a larger sample in 1990. Results revealed that 16% of Canadian adults do not have sufficient literacy skills to handle everyday reading and writing tasks and that a further 22% are unable to cope with more complex tasks (Brokop, 1991). While these statistics have led to the hysteria noted at the beginning of this section, it is important to keep in mind that both census results and the results of the Southam and Statistics Canada surveys provide only a rough indication at best of the extent of illiteracy in Canada.

The crisis mentality often includes the notion that the illiteracy problem is getting worse rather than better. Graff (1987) refers to this as the myth of decline and argues that the so-called decline has yet to be established over a meaningful time frame. He notes that comparable test results exist only for the past decade and comparisons fail to take into account changes in socioeconomic and demographic profiles of student populations in high school and postsecondary settings. Stedman and Kaestle (1987) agree and add that the decline pales when compared to the increase in educational attainment of the population in general over the past 40 years. Finally, Ryan (1985) suggests that “the problem is not a deterioration of reading skills so much as an increase in the levels of education required to participate in an increasingly complex economic and social environment” (p. 380).

The second type of data used to support the crisis argument involves cost estimates. These are based on information that persons with limited education are often the same persons who suffer from one or more of the other major social ills—poverty, unemployment, racial or ethnic discrimination, social isolation, and so forth. (Hunter & Harman, 1979). A causal connection is frequently assumed that Hunter and Harman maintain is reflected in two related literacy myths—first, that literacy is the primary cause of progress, and second, that illiteracy is the cause of poverty and injustice. In the United States, estimates of the costs of illiteracy have been as high as \$225 billion yearly in poor job performance, welfare, crime, unrealized tax revenue, and related social ills (Goddard, 1987). Estimates in Canada have been at about \$2 billion yearly (“Study Hopes,” 1987). While these may be fairly reliable measures of the costs of the social ills outlined, to state that this is the cost of illiteracy per se is clearly an overstatement.

The Power of Literacy

Also overstated are the benefits accrued to literacy. Bhola (1981), for example, indicates that literacy radically changes the way the new literate thinks (*cognitive* outcomes) including such attributes as independence, objectivity, holding individual opinion, capacity for logical analysis, sense of history and universalism. Some of the *social* outcomes of literacy, according to Bhola, include higher income, safety on the job, capacity for increased participation in political institutions, status, and acquisition of modern characteristics such as “keeping informed about the world and taking an active role as a citizen; ... manifesting a sense of personal authority in family, tribe, and sect, and the development of newer nonparochial loyalties; and the concomitant granting of more autonomy and rights to those of lesser status and power, such as minority groups and women” (Bhola, 1981, p. 12). Literacy is also viewed as having *cultural* effects in that the literate individual has improved capacity as a “maker of culture and a creator of knowledge” (p. 12). Finally, Bhola claims that literacy “can make us more fully human” (p. 12).

In contrast to the grandiose statements of Bhola and others, Graff (1987, p. 61) argues that we overvalue literacy and attempts to revise what he refers to as pervasive, uncritical, and outmoded assumptions about the place of literacy in social and individual development. He along with other historians, sociologists and anthropologists (Hunter & Harman, 1979; Levine, 1986;

Olson, 1988) point out that increased literacy is as likely to be an outcome of economic development as a cause of it. From a sociological perspective, Hunter and Harman (1979) state:

Research suggests that poverty and the power structures of society are more responsible for low levels of literacy than the reverse. For most persons who lack literacy skills, illiteracy is simply one factor interacting with many others—class, race and sex discrimination, welfare dependency, unemployment, poor housing and a general sense of powerlessness. The acquisition of reading and writing skills would eliminate conventional illiteracy among many but would have no appreciable effect on the other factors that perpetuate the poverty of their lives. (pp. 9-10)

Levine (1986) based on his work in Great Britain agrees, stating that the attainment of functional literacy rarely produces outcomes such as employment, personal and economic growth, job advancement, or social integration. In an Edmonton study, Faulk (1987) did not find that the employment status of adults improved as a result of participation in literacy programs.

From a historical perspective, Graff (1987) notes that across time the stratification of literacy has paralleled the stratification of occupations and wealth, and that “the reduction in illiteracy in nineteenth century England ... would appear more as a cultural change wrought by economic growth than as a cause of growth” (p. 66). Anthropological studies have shown that “while literacy was a critical resource, in itself, it did not account for the changes associated with literacy in Western societies” (Olson, 1987, p. 1).

Before leaving this myth regarding the power of literacy, it is important to point out that all uses of literacy may not be desirable. According to Graff (1987):

literacy and education are better viewed as necessary and not sufficient prerequisites for popular rule and democratic right. The powers of literacy and schooling for control, the negative aspects of education, must be fully recognized. Literacy can and has been employed for social control and for political repression as well. (p. 70)

It appears, then, that we need to question both the crisis myth and the myth that we can solve social problems with literacy programs. According to Sticht (1988), the crisis mentality has spawned many largely unsuccessful quick-fix programs.

Assumptions Underlying Selected Issues in Literacy Education

Reading, Writing, and Literacy

Historically, the term *literacy* was primarily the domain of adult educators but in the late '70s, it began to appear in the literature on the earliest stages of literacy development as educators shifted from a focus on reading readiness to emergent literacy. From a reading readiness perspective, the major focus was on when children were ready to learn to read (Morphett & Washbourne, 1931) or on the relationship of predictor variables such as visual perception, auditory discrimination, and motor coordination with subsequent reading achievement (e.g., deHirsch, Jansky, & Langford, 1966). The focus was on schools, what happened in schools, and on the individual children

themselves with little regard to their broader environment. Reading readiness was clearly conceived as an educational phenomenon.

When reading readiness was reconceptualized as emergent literacy, it was viewed as a continuous process occurring over a long period of time and research changed markedly. However, emergent literacy was still primarily seen as an educational phenomenon as evidenced in Sulzby's (1991) definition of emergent literacy as "the reading and writing behaviors of young children that precede and develop into conventional literacy" (p. 273). The focus of much research in the '80s was on the context of literacy development and on the nature of the interactions between children and significant adults in their lives both in the home and school contexts (Bissex, 1980; Doake, 1981; Juliebo, 1985; Taylor, 1983). The home was considered to be a critical partner in emergent literacy development but the sociopolitical implications of this partnership were recognized by only a few researchers (Taylor, 1983).

The terms *reading* and *writing* still tend to dominate the literature on older children, and these terms clearly have school connotations. The terms imply that reading and writing are essentially educational phenomena and that they have little to do with social or political aspects of children's lives. Indeed, the terms imply that reading and writing are neutral, a highly questionable assumption. As Giroux (1983) and Kretovics (1985) point out, schooling plays a vital role in the reproduction of social and economic relations. This is reflected nowhere more clearly than in the statistics gathered by the Southam News survey (1987) that show that illiteracy is highest among the poor and minorities.

Overall, increased use of the term *literacy* in the literature on children and on what happens in schools has changed little about how literacy is viewed or taught. Literacy continues to be seen as primarily an educational phenomenon and as such essentially neutral. The focus is still on the individual child with literacy development viewed as individual achievement when it is successful and as an individual failure when it is unsuccessful. Partly because of uncritical acceptance of the power of literacy myth, school progress is generally defined in terms of success in reading and writing. It is important to note, however, that this does not reflect "the way the world is" but rather the views of those who have the power to decide "what counts."

Skills or Processes in Reading and Writing

The skills versus processes controversy has included both reading and writing although disenchantment with skills approaches was evident in the literature on reading before that on writing. By the late '60s and early '70s, skills approaches to reading were being viewed as essentially atheoretical and as failing to achieve the North American dream of universal literacy. A decade later, the skills approach to writing was coming under criticism.

Skills approaches are based on the underlying assumption that reading and writing can be taught to children by breaking them down into component skills to be learned one at a time, often through drill and practice. Proctor (1986) notes in relation to writing

The ideology contained in this curriculum is essentially reductionist; that is, it assumes that the parts are equal to the whole, and that by breaking the

process of writing into discrete elements learning to write is somehow simplified and, thus, made easier. This is the assembly-line view of language development, wherein the lessons which have been learned from mass production methods used in industry are conceived of as being readily applicable to learning in classrooms. (p. 28)

The influence of industry has also been evident in reading instruction. In the late '60s and '70s, teaching machines reflected this orientation and criterion-referenced programs nearly eliminated the need for teachers much as present-day factories eliminate the need for workers through automation. Teachers became managers of programs rather than teachers of children. This reliance on industry seems related to the close link assumed to exist between literacy and economic development, one of the myths discussed earlier in this article.

The shift from a skills to a reading processes focus did not originate in the '70s, but can be traced back to at least the work of Huey in 1908. However, reading processes were a primary focus of reading research throughout the '70s and '80s (e.g., Kamil, 1984), and this has continued into the '90s as well. A major argument for a process approach was the need to have reading instruction based on an understanding of how children actually read rather than on a priori lists of reading skills deriving from neither theory nor research. The major emphasis has been on learning rather than on teaching, on the child rather than the teacher, and on the how of reading rather than the what. Product has been eschewed in favor of process, and research has tended to focus on the cognitive operations of children as they read. Much of my own research has reflected this orientation (e.g., Malicky & Norman, 1982; Malicky & Norman, 1989; Norman & Malicky, 1987) and my clinical work has been driven by a model of reading processes (Malicky, 1987).

The theoretical framework for this research has come primarily from cognitive psychology, particularly from the area of information processing (Schallert, 1991). Not only have reading educators in the '70s and '80s relied on cognitive theories, but cognitive psychologists have made a major contribution to this research. In fact, cognitive psychology has virtually dominated reading research since the late '60s. The reliance on psychology has, in general, reinforced the focus on the individual and diverted attention away from sociopolitical aspects of literacy.

While cognitive psychology has had some influence on views of the writing process (Flower & Hayes, 1981), the impetus for the shift from skills to process in writing came instead from writers (Murray, 1985) and language arts educators (Calkins, 1983; Graves, 1983). And partly because of the limited attention to writing in elementary schools prior to the '80s, this shift had more influence on classroom practice than that in reading. Process writing appears to provide possibilities for responsibility, freedom, and control for students. Much has been written about children taking ownership of their writing (Graves, 1983; Harste, Woodward, & Burke, 1984). However, although Graves (1983) stressed the need for children to make decisions about their own writing, the authoring cycle or process writing, in practice, has often been used prescriptively. How much freedom do children really have when we require them to "choose topics on their own, rehearse informa-

tion, write, reread what they have written, and revise" (p. 169) every time they write? Innes (1991) recently described a grade 6 classroom where other than the children choosing their own topics, the expectations and activities in a book writing project were the same for everyone. The children all went through the same stages and their work had to be initialled by a teacher after each stage before they were allowed to proceed. To ensure quality of presentation, one teacher typed children's stories, another used a sewing machine to sew pages and the third photocopied stories to facilitate illustrating. This is not unlike the assembly line described above by Proctor (1986).

The trend to a focus on processes has not been without its critics. One of the harshest critics was Hirsch (1987) who argued that the content of instruction ought to be "traditional literate knowledge, the information, attitudes, and assumptions that literate Americans share" (p. 127). He termed this *cultural literacy* and drew up lists of prescribed readings. While Hirsch's ideas are not new, they helped to accelerate the movement toward an increased focus on literature in elementary school programs in the past decade, a move applauded by most language arts educators. However, although "good" literature is preferable to "Dick and Jane," Brause and Mayher (1991) caution that we must be careful that equality and freedom from this perspective do not become "the freedom to be successful by joining the mainstream, established traditions and practices of the elected, powerful governing elite" (p. 260). Bloome (1991) points out that use of good literature raises issues of "who gets to do the choosing, as well as how, when and under what circumstances and what meanings are assigned to those choices" (p. 52). The definitions of what is good literature are those of more powerful groups, and less powerful groups may not be entitled to tell their stories or have their stories included in the literature selected.

Another critic of the process approach has been Delpit (1988) who indicates that process writing deprives children of color of the opportunity to learn what they need to know to gain access to power. She maintains that "Teachers do students no service to suggest, even implicitly, that 'product' is not important. In this country, students will be judged on their product regardless of the process they utilized to achieve it" (p. 287). In a similar vein, Fagan (1990) indicates that "if individuals wish to challenge the present system, they must be able to meet the power brokers on common literacy grounds; otherwise they will be at a disadvantage" (p. 15).

Fagan and Delpit are both referring to the power aspect of literacy that has been predominant in the writing of Freire (1970). But for Freire, power does not involve fitting in with the existing sociopolitical structure, but rather becoming aware of inequities and existing contradictions in society in order to change rather than adapt to them. For him, the what of literacy instruction is critical and ought to originate from people and their circumstances. However, the what would not be the selection of "good" literature by language arts experts. The range of content included in elementary school literacy programs needs to be broader than ever before if one of the goals is to provide equal opportunities for all children. But equal opportunities are not even enough; there must also be a commitment to equality of results. Unless this is achieved, Brause and Mayher (1991) maintain that

“the current practices of segregation and tracking will continue to make a mockery of equality of opportunity” (p. 270).

Overall, both skills and process approaches to literacy education reflect similar views about what literacy is and what it is for. Both focus on the educational nature of literacy and ignore the sociopolitical dimensions. Both focus on the individual. In fact, for years I viewed the child-centered focus of this shift as one of its greatest strengths. But focusing on the child as an individual rather than as a member of his or her social group may isolate the child even further. Possible outcomes of individualized reading include alienation of the child and making him or her even more powerless than before. More and more adult literacy educators are advocating the movement away from the each-one-teach-one format of volunteer tutoring programs to community-based programs in which people work together both to read the word and the world (Freire & Macedo, 1987; Kozol, 1985). The heavy focus of process approaches on the how of literacy detract attention from more critical questions regarding the why and what (Malicky, 1990).

Standardized Tests and Portfolio Assessment

There has been considerable criticism of standardized tests in recent years. Field (1990) notes that test items are selected for their discriminatory power, “that is chosen deliberately to produce failure among some and success among others” (pp. 108-109). In other words, reading failure is a necessary outcome of norm-referenced reading assessment. Brause and Mayher (1991) indicate further that while there have been dramatic changes in assessment over the past decade, demographic data show that these changes have been overwhelmingly counterproductive for the most needy children.

The limited and limiting tests have emphasized and exaggerated the differences among our students. This has had the effect of emphasizing what they cannot do, rather than what they can do. Further, it has labelled them as potential or actual failures and greased the skids toward their early departure from school. (p. 270)

In lieu of tests, Goodman (1991) has advocated kidwatching, and more recently, the focus has been on portfolio assessment (Mathews, 1990; Paris, 1991; Valencia, 1990). Valencia (1990) indicates that portfolio assessment has the following advantages: it is authentic; it is a continuous, ongoing process; it is multidimensional; and it is collaborative between teacher and student. “It is a philosophy that honors both the process and the products of learning as well as the active participation of the teacher and the students in their own evaluation and growth” (p. 340). However, does portfolio assessment reflect a real change in how literacy is viewed or treated in schools?

One basic aspect that has not changed is that reading and writing are still viewed as individual activities with individual accountability. In relation to writing assessment, Bloome (1991) maintains that

the change in assessment maintains individual accountability, individual comparison, and definitions of writing instruction as progressive individual skill accumulation. The change in evaluation maintained the former relationships of students, teachers, and evaluators with regard to authority for what determines what counts as good writing and how it should be done. (p. 50)

Field (1990) uses the metaphors *sitting beside to assist* and *sitting above to judge* to elucidate potential differences between portfolio and standardized testing. However, as long as teachers use portfolios to make judgments about children, this potential will not be achieved, and Field points out an even more serious problem. He alludes to the dark side of informal assessment by citing Broadfoot (1984)

the replacement of formal selective tests and examinations with progressive orientations based on teacher's continuous assessment.... may in practice be a more insidious basis for social control.... thus pupils who for reasons of family background or personality cannot or will not conform to the desired stereotype risk, under such an orientation process, being cooled out long before their potential warrants. (Field, 1990, p. 141 citing Broadfoot)

By appearing to sit beside rather than sit above children, Field (1990) suggests that we may be subjecting children to a more intensive and penetrating form of power and social control. When children put everything they do out in the open, they "let their guards down completely" (p. 191).

It seems likely that with the focus on individual accountability in literacy and with reading in particular still considered to be critical to school progress, the movement to portfolio assessment will do little to solve the problem of inequality for children who come to school from poor and minority homes. There is already pressure on teachers to develop standard criteria for evaluating material included in portfolios. A set of descriptors could facilitate communication about children's literacy development much as we describe their artistic development. However, if these descriptors are correlated with age levels, we will simply be exchanging the norm tables on standardized tests for norm tables based on our opinions. Farr and Carey (1986) state that in the absence of any agreed on list of critical reading or writing skills, we are likely to list the things *we* know. This may lead to even more biased assessment than in the past, and as with standardized tests, we will again create failure and successes through our assessment and by so doing add fuel to the crisis mentality surrounding literacy.

There is little doubt that we need to describe the reading and writing of children to help us plan appropriate instruction to facilitate their literacy growth. However, by using age-related measures, we invite only some children (those who are successful) into the "magical circle of the literate" (Bhola, 1981) or, as Smith (1988) calls it, the literacy club. Others (those who are not successful) are marginalized by our definitions of literacy success and failure. Amoroso (1984) in a study of literacy in a prison context described literacy as a dream of becoming someone for many of the people in his study. Literacy has as much to do with who we are as with what we are able to do. We must build structures into our schools that serve to include rather than exclude children from literate society.

Learning Disabilities: A Focus on the Individual

All three changes discussed to this point focus on the individual, but the individual focus has been even more evident in the movement to learning disabilities as an explanation for reading problems. Most previous explanations had also focused on the child as the source of the problem, for example,

emotional disturbance, mental retardation, neurological dysfunction; the major exception was cultural deprivation. With the advent of the learning disabilities explanation, there was a movement away from compensatory education to remedial programs specifically designed for each child, that is, the individual education plan. The spotlight was removed from society (homes and schools) and responsibility for the reading problem was placed squarely on the child (Coles, 1978) despite the fact that there are many more children who experience reading difficulties from homes of the poor or minorities than from middle-class homes. In fact, the exclusionary clauses of definitions of learning disabilities effectively excluded many minority children from access to remedial reading programs provided through learning disabilities funding.

The learning disabilities explanation was appealing to educators because it defined the child as the one who needed to change to fit the system rather than defining the problem as existing in the schools or society at large. Special programs were provided for children but no changes were suggested to the system that provided unequal opportunities and outcomes for the children in the first place.

Coles (1978) suggests that learning disabilities involve providing a medical or biological explanation for a problem that requires a social solution.

By positing biological bases for learning problems, the responsibility for failure is taken from the schools, communities, and other institutions and is put squarely on the back, or rather within the head, of the child. Thus, the classification plays its political role, moving the focus away from the general educational process, away from the need to change institutions, away from the need to rectify social conditions affecting the child, and away from the need to appropriate more resources for social use toward the remedy of a purely medical problem. (p. 333)

According to Giroux (1987), the label doesn't merely divert attention from the need for social solutions, but also further disadvantages at-risk learners. He is concerned that by having lower expectations for these children, we disempower them further by failing to give them knowledge they need to deal with their everyday lives.

This is not to argue that biological factors are never involved in reading disabilities. Rather, the argument is that by focusing on learning disabilities as residing within children, we lose sight of the fact that this way of assigning meaning and identity to children is socially and culturally determined and as such can be socially and politically changed. We could, for example, consider it acceptable for children at the same age to read and write with different degrees of proficiency much as we expect and accept this in areas such as visual arts and physical education. With less mythology and hysteria surrounding the latter areas, we are willing to accept individual differences and help each child develop at his or her own rate. No one is marginalized; no one is excluded.

The real question for many, though, is whether or not children do learn to read and write better once they have been identified as learning disabled and placed into special programs. This is the major justification for labeling children. However, results of studies on the efficacy of special programs in

resource rooms and special education classrooms have been equivocal at best (Carlberg & Kavale, 1980; Glass, 1983; Haynes & Jenkins, 1986). Rather than questioning the appropriateness of this way of defining children, these results have been interpreted by many as indicating that we have not yet found the best way to teach children once they have been identified. This search for the best way to teach literacy has diverted attention away from the sociopolitical dimensions of learning disabilities, and it is even more pronounced in the learning to read debate.

Wholes versus Parts in Learning to Read

Perhaps no aspect of literacy has been more strongly debated than the beginning stages of learning to read. Chall's (1967) influential book *Learning to Read: The Great Debate* illustrated the polarization of views in the 1960s between those who believed that children should be taught with phonics versus those who supported whole-word approaches. This polarization was recently resurrected by Adams (1990) in *Beginning to Read: Thinking and Learning about Print* with whole language replacing whole-word approaches. Both reached essentially the same conclusion—children need to learn about the letter-sound relationships in written language. Neither addressed the question of why it is important that children learn to read or why more poor children and those from minority backgrounds fail to learn to read than those from middle-class backgrounds no matter what approach is used.

On the surface, whole language seems to reflect a view of literacy quite different from that in bottom-up programs where reading is broken down into subskills to be taught one at a time. Goodman (1986) characterizes language in a whole language program as being meaningful, part of a real event, having purpose for the learner, and being accessible to the learner. He characterizes the learner as having power to use the language. From these characterizations, it would appear that whole language has potential for reaching the emancipatory goals of literacy adopted at the International Symposium for Literacy at Persepolis in 1975. Based on ideas of Freire (1970), literacy was viewed as creating

the conditions for the acquisition of a critical consciousness of the contradictions of society in which man lives and of its aims; it also stimulates initiative and his participation in the creation of projects capable of acting upon the world, of transforming it, and of defining the aims of an authentic human development. (Hamadache & Martin, 1986, pp. 128-129)

Rather than focusing on these emancipatory possibilities, however, the debate has tended to focus on whether children are taught spelling or phonics in whole language programs. Most children, particularly those from middle-class families, will learn how to read no matter whether we use a phonics approach or a whole language approach because they have been read to many thousands of hours before they arrive at school and hence can make sense of phonics instruction. Alternatively, they may have already figured out much about the sound-spelling patterns of our language as they experimented with writing at home. However, many children from poor or minority homes arrive at school without this advantage and either cannot make sense of phonics instruction because they do not know how written language works or

cannot figure out the relationships between spelling and sound patterns without a great deal more mediation than they generally receive from their teachers.

As with the other issues considered in this article, the whole language debate tends to focus on the view that literacy is an educational phenomenon and on children as individual learners rather than as members of communities. While there tends to be more focus on cooperative learning in whole language than in most traditional programs, assessment practices still make literacy learning an individual, competitive enterprise. The important questions about empowerment and change have rarely been addressed by critics of whole language. As pointed out elsewhere (Malicky, 1990), this may have occurred because whole language has essentially been basalized in Canada. Shannon (1989) notes that the basalization of whole language in combination with the adoption of commercial series by provincial governments has removed control and power from children and teachers and placed it in the hands of publishers and editors. Hence the potential of whole language to meet the emancipatory goals of literacy has effectively been neutralized.

Summary and Implications

My major reason for engaging in the kind of reexamination presented in this article stems from 17 years of clinical work with children and adults defined by schools, society, and themselves as failures in literacy learning. Despite apparent improvements in teaching reading and writing, the situation for these children and adults has changed very little. I began my reexamination convinced that literacy is important to both schooling and life—written language is a convenient and economical way to communicate ideas across time and space. I still believe this, but in our society literacy is viewed as far more than the ability to deal with written language. The crisis mentality and an unquestioned belief in the power of literacy have led to a focus on the how of literacy education—how to teach reading and writing more effectively—with little attention to questions regarding the goals. Only a few of the myths and issues surrounding literacy have been considered in this article but even from this limited examination, a number of underlying assumptions are clearly evident.

First, the focus in literacy education is clearly on the individual. Stress is placed on individual competition rather than cooperation and on individual gain rather than social justice.

Second, literacy is generally viewed as an educational phenomenon. Because of how overvalued literacy is in society, however, it has as much to do with social identity as with constructing meaning from written language. The belief that literacy is educational in nature is related to a further assumption that literacy is neutral, but there are ample statistics to show that illiteracy is higher among the poor and minorities than the rest of the population. Generally, the sociopolitical dimensions of literacy are not recognized, and when they are there are conflicting views regarding whether the poor and minorities should develop the skills and knowledge of the powerful so they can take their place within the current system (e.g., Delpit, 1988) or whether they should develop skills and an awareness of contradictions in

society so they can bring about sociopolitical change. The argument is often presented that the system won't change so we will have to try to change children and adults to fit the system. This is, in essence, what I have been attempting to do in my 17 years of clinical work, and in doing so I have inadvertently supported a system that has been responsible for creating inequalities in the first place. My work has had little to do with empowering individuals and much to do with legitimizing a system that discriminates against certain segments of the population.

A major culprit has been assessment, but our assessment techniques, are merely a reflection of the myths and assumptions we hold about literacy. Because of the power with which we imbue literacy, we have decreed that all individuals must reach certain levels of literacy at specified age levels. To check that we are achieving this goal, we have selected test items designed to pass some individuals and fail others. In other words, by selecting test items to discriminate among individuals, we have predetermined that a certain percentage of the population will fail. But passing and failing is defined as residing within the individual rather than within the assessment techniques, and this is particularly obvious when we label those children who fail to learn to read and write well as being learning disabled. The tests have done their job; they have removed the responsibility for failure from schools and society and placed the blame for this failure on the individual. Coles (1978) refers to this as a classic case of blaming the victim.

A third assumption reflected in our myths and debates regarding literacy has been a belief in technology and in an industrial model of education. We view literacy as the cause of economic development and industrial models as appropriate for planning instructional programs. Assembly-line models permeate much of what we do, and the learning to read debate had been based on the assumption that there is a best way to teach all children. Better methods are seen as the solution not only for illiteracy, but also for the problems associated with illiteracy. However, as Graff (1987) notes, literacy is not the only problem nor the only solution. Much more comprehensive changes in the sociopolitical structures of society are needed to solve problems of poverty, discrimination, unemployment, welfare dependency and powerlessness.

Freire (1970) suggests that an important first step in social change is conscientization. It is crucial that we become more aware of the myths and assumptions that drive much of what we do in literacy education. Only by becoming aware of the contradictions in what we do will we be able to decide what changes are needed and begin to work toward these changes.

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Deconstructing Reflection¹

Educational theory as well as educational practice are implicitly dominated by a language frame that structures thought and practice into an input-output form. In this paper I attempt to identify this frame and the way it has predetermined much of our discourse, historically and in the present day, and offer an alternative frame which if nothing else makes us aware that the input-output frame does not necessarily disclose reality.

We live today in the age of the electronic computer, and that technology has served to shape much of our thinking about how education can and should proceed. We speak of thinking as "information processing" and teaching and learning as "programming," "assembly," or "debugging." ... Attention is needed, however, as to how the computer as metaphor affects our understanding of the processes of learning and teaching. (Kilpatrick, 1985, p. 1)

Although reflection is by no means a recent cognitive phenomenon, it has become a major focus in recent educational research and practice. Yet because reflection has a long history in various forms of consciousness,² the recent surge in interest is likely indicative of current cultural forces, inclusive of technology, that make reflection particularly attractive and perhaps seductively so as a way of conceiving if not resolving educational problems. The introductory quotation, highlighting the computer as a hegemonic metaphor pervading education, gives some indication of the pervasiveness of the computer metaphor. However, what the quote does not show, and indeed may even be a victim of, is the silent yet overpowering constraint that this metaphor brings to our understanding of reflection.

It is the intent of this article to deconstruct the implicitly pervasive presuppositions in the computer metaphor as a way of identifying a profoundly different, if not significant, articulation of reflection and recursion. I wish to present an alternate view not as a replacement for the one embedded in the computer metaphor, but as a way of becoming more aware of meanings that are often difficult to discern in the computer metaphor. With this in mind, consider two other statements about reflection from Kilpatrick (1985):

We somehow move into another dimension when we reflect on what we have done. In reflecting on our experience, we move out of the plane of our

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everyday existence. We give meaning to experience by getting outside the system. (p. 6)

Recursion, too, requires that the user step outside the system.... To see how recursion works, one needs to get outside the process itself and, so to speak, look down on it from above. (p. 8)

It seems clear that from these two statements “getting outside the system” is a requirement for either reflection or recursion: If we cannot in some sense get outside our present experience, it would not be possible to reflect upon it. A wide sector of the education community would likely agree that “getting outside the system” does express an important condition for reflection and of recursion. Even the use of rather recent research tools such as journal writing, conferencing, consulting with an outside reader, and narrative inquiry generally can be seen as methods for getting outside our experiences in order to see them in a different way. As I endeavor to show however, the above two statements receive their cogency largely because of the dominance of a particular orientation toward experience, an orientation captured rather succinctly and most recently in the computer metaphor. More generally, however, and more pervasively, this same orientation is identified and analyzed at the level of “human communication” in what Reddy (1979) calls the *conduit metaphor*. Within alternate metaphors, these two statements may appear much less cogent or even false. I refer to the problematic “truth” or “falsity” of these two statements as our *Dilemma*.

In order to explicate our Dilemma may I engage in a little make believe: Suppose with me that these two statements were *theorems* in a mathematical system. As a thought experiment let us assume that these two theorems are false. Assuming coherence in the system, it follows that the falsity of these theorems is necessarily due to falsity in one or more of the *postulates* generating the theory. Let us ask:

1. What might these postulates be?
2. What ontological stance is supportive of these postulates?
3. What alternative ontological stances may be appropriate?
4. What particular postulates could be specified within this alternate ontological stance?
5. What meaning do reflection and recursion have given the alternate postulates?
6. What relations exist between the original postulates and the alternate ones, and what sort of pedagogy is implied by these relations?

Question One: The Suspected Postulate(s)

Kilpatrick (1985) offers a clue:

One can think of a computer—and a mind—as an information-processing device capable of at least three types of processes: assembly, performance, and control. Roughly speaking, assembly processes translate incoming information into a usable form, performance processes use that information together with information stored in memory to produce some outcome, and control processes manage the sequence. (p. 23)

The above remarks are a succinct and explicit expression of the well-known and pervasively used *Input-Output* (I-O) frame that tacitly as well as explicitly pervades cognitive science and learning theory in particular. According to Iran-Nejad (1990):

Two tacit assumptions seem to govern academic learning: (a) Learning is internalization of external knowledge, and (b) it occurs under conscious executive control. The first assumption implies that external information is the one and only source of learning, and the second suggests that executive control is the one and only internal source of self-regulation of learning processes. (p. 573)

These assumptions are not an arbitrary concoction of learning theorists or cognitive scientists; rather, they are deeply and tacitly embedded in the very texture of our language and culture. Referring to these assumptions as the conduit metaphor (i.e., the general inclination for us to *frame* and therefore to interpret our experience in terms of an input, a channel or conduit, and an output), Reddy (1979) claims that:

[the] evidence suggests that English has a preferred framework for conceptualizing communication, and can bias thought process toward this framework, even though nothing more than common sense is necessary to devise a different, more accurate framework. I shall thus be trying to convince you of what may be a disturbing premise: that merely by opening our mouths and speaking English we can be drawn into a very real and serious frame conflict. My own belief is that this frame conflict has considerable impact on our social and cultural problems. If we are largely unable, despite the vast array of communications technologies available to us today, to bring about substantive improvements in human communication, it may well be because this frame conflict has led us to attempt faulty solutions to the problem. (p. 285)

The problem of frame conflict that Reddy identifies is particularly disturbing if we agree with Schön (1979) that frame conflicts are immune to resolution “by recourse to the facts” (p. 256). Even more disturbingly, such stubborn conflicts of perspective are “full of potential for violent contention” and harsh words if not harsh actions.³ The ongoing conflict between labor and management or labor and government in Canada may largely be a matter of frame conflict, and as long as the frames themselves are never discussed, the conflicts are likely to continue unabated. Canada’s constitutional crisis is likely another example of frame conflict. In the case of this article, I am suggesting that our differing ways of understanding reflection are another example.

If this is so, it may be worthwhile to briefly consider Reddy’s (1979) demonstration, through an abundance of everyday sentences, of how the conduit metaphor pervades and implicitly frames not only what we say and how we say it, but how we think. Let me provide some examples.

1. “Put your ideas into better words.”

In asking for this we may be thinking that we are only helping to clarify the ideas, but we are also imposing the frame that words are “vehicles” or “containers” for embodying ideas. We then “get our ideas across” more clearly if we choose the most appropriate “delivery vehicles” for doing so.

This frame is the “conduit metaphor” and words themselves are conduits for ideas.

2. “Teachers must implement the curriculum.”

Here the process of implementation is a conduit for delivering the curriculum. The longstanding practice of educational experts “developing” the curriculum which is then “implemented” by teachers is thus framed within the conduit metaphor. Much of the field of “Curriculum Studies” has been framed in this way. Postmodern critiques are largely a way of exposing the nature of this type of framing.

3. “The text conveys the message.”

Here text is conduit to deliver messages. In paradigmatic form, the information is encoded into text, the text carries the information, and the reader or interpreter decodes the text. Much of reading theory is still dominated by this model.

4. “We had a good exchange of ideas.”

Here the conduit metaphor is implicit in the process of exchange. We often talk about a discussion as if it were an “exchange of ideas,” and yet how does a mere exchange of information lead to the sometimes ecstatic experiences that are generated in some “lively” conversations? Perhaps more than an exchange of information is happening despite our tendency to frame in this way.

5. Here are a few other examples presented without commentary.

Schools are the most recent way of delivering education.

Who *gave* you that notion?

Is there a *program* for tonight’s concert?

An experimental design is a rigorous means of processing the input so that the output is interpretable with maximum clarity.

In an educational system, objectives prescribe the input; instruction delivers them; evaluation assesses the output.

Your poem contains silly thoughts.

Why did we believe that light required a *medium* in order to propagate?

Reddy (1979, p. 290) summarizes as follows:

1. Language functions like a conduit, transferring thoughts bodily from one person to another;
2. in writing and speaking, people insert their thoughts and feelings in the words;
3. words accomplish the transfer by containing the thoughts or feelings and conveying them to others;
4. in listening or reading, people extract the thoughts and feelings once again from the words.

Reddy (1979) found that “of the entire metalinguistic apparatus of the English language, at least seventy percent is directly, visibly, and graphically based on the conduit metaphor” (p. 298). As such, it is not surprising that the I-O frame seems so “obviously” appropriate in Western thinking. But there is a potential blindness lurking in such obviousness that, as Reddy argued, can produce a kind of pathological dependence in our attempts to understand learning or reflection and recursion, “the conduit metaphor can confuse serious attempts at theory building” (p. 307). Indeed, the metaphor has

become so hegemonic that even 30 years ago McLuhan could so prophetically conclude that “The medium is the message.”

More sinister is Reddy’s (1979) warning that, “the conduit metaphor is leading us down a technological and social blind alley ... with mass neglect of the internal, human systems responsible for nine-tenths of the work in communicating” (p. 310). With this in mind, and realizing that the I-O frame is but a particular instantiation of the conduit metaphor, to say that a system “reflects upon itself” means that the system itself becomes *input* to itself. In order for something to be an input, that something must be outside the system into which it is *put*. Therefore, under the conduit metaphor, it is “obvious” that the system must, as Kilpatrick says, “get outside itself” in order to become input to itself. Reflection under this frame thus necessitates “stepping outside oneself.” Because the I-O frame is so pervasive in our society as a metaphor (and in science as a model), the necessity of stepping outside ourselves, like the necessity of Euclid’s postulates, seem *self-evident*. Thus the suspected postulate is the I-O frame itself, interpreted as a particularly concrete instantiation of the conduit metaphor.⁴

Question Two: Ontology of the I-O Postulate

Strategically speaking, we were led to the I-O frame as the hidden postulate by imagining that Kilpatrick’s two statements were “false theorems” traceable to “false” postulates in a mathematical system. We now seek to trace the origin of the “false” postulate in a deeper “false” ontology.⁵

To say that a mind must step outside itself already acknowledges that there is an inside from which to step outside. The inside must be distinguishable from the outside much as a topological closed curve separates a region into an inside and an outside. The ontology of this stance sees the universe as a collection of distinct “insides” (commonly called *objects*, and human beings could be one such) each of which is separate from its outside (commonly called the *environment*).

This ontology I call the *Separation* ontology. That it is a proper context for the I-O postulate is understandable when it is seen how this postulate provides the infrastructure for *explanation* within the separation ontology: Having begun with the stance that the universe is separated into discrete objects, explaining anything more complex than a single object entails finding some way to *connect* the separated objects. The general form for such connection is the conduit metaphor; thus this metaphor is of necessity pervasive in everyday language. In the realm of science and technology the solution to the connection problem is, as one might guess, the I-O postulate: Any object can be theoretically connected to any other object through some hypothesized input-output process. Such processes are standard fare as well as ubiquitous in all sciences.

It may sound trivial, but the fundamental function of the I-O postulate is to *bridge* the original ontological “cut” made in distinguishing object from environment.

This statement may sound far-fetched and even unbelievable to us. I suggest that such unbelievability is itself an indication of the hegemony of the I-O frame. The perplexing difficulty, however, is that the solution (the I-O

postulate), in being a general frame for *repairing*⁶ ontological cuts, is now seen as the the mode for all *repairs*, the way for all *progress*, the way to all knowledge, even the way of speaking about communication. It is now taken for granted that progress is a matter of showing how new connections can be made across the infinity of cuts in the now pervasively separated universe, the so-called *Cartesian split* (see Jones, 1982, especially pp. 51-78).⁷ In education, this sort of progress is named *Integration*, which again is an obviously “good” characteristic of any educational process. For example, no one argues against the value of, at some point or some level, integrating different subject areas. Integration is thus seen as a solution to our problems of separation. Is it worth asking how it is that we are so dominated by separation (or specialization) as the only way to move ahead? In this sense, integration may simply be an artifact of our current frame.

As a simple instance of the pervasiveness of the I-O ontology in our everyday thinking consider our bodies. It is “natural” if distasteful for us to think of our basic bodily functioning as intaking food and excreting waste, a simple input-output description. We might even ask, “How else could we describe these actions?” Isn’t it obvious that we intake food and output waste? We *ARE* an I-O system. Our stomachs are *inside* and the food is *outside*. In order to survive we must *intake* food and *output* waste. It definitely is not a matter of language; it is a matter of *concrete physical REALITY!* How can I deny this?

I won’t deny the truth in the above description. I can, however, offer an alternate interpretation of the *concrete physical reality* mentioned above. Consider the two structures shown in Figure 1. From an Euclidean point of view these two structures are quite different; certainly they are not congruent. Figure A seems to have an *inside*. Indeed the upper opening could be a mouth and the lower orifice could be a rectum. That is, it can be described as an input-output structure. However, without any tearing or ripping or *cutting*, this input-output structure can be transformed into the *topologically equivalent* structure on the right. In looking at this “donut,” it seems that what was so obviously the “inside” is no longer inside at all: What was formerly seen to be inside is now simply in the hole of the donut. But to be in the hole is to be outside the donut; the former inside is just as outside as the former outside. So inputting and outputting as a process was just a way of describing a certain kind of presence of things as they moved along a boundary (membrane). And since topologically these forms are equivalent, the former basis for distinguishing inside/outside has completely self-destructed if not deconstructed. The input-output description, then, is just a way of (a frame for) talking about what happens along a boundary. It is not the only frame one could use as biologists Maturana and Varela (1980) reveal. Topologically speaking, then, it is no longer “obvious” that, being equivalent to a donut, we are in reality an input-output structure. It is interesting to note that as a branch of mathematics, topology is a rather recent development. It has to do with things like *neighborhood*, *proximity*, *nearness*, words that remind us of *situatedness* rather than *input-output*. But because topological thinking is not hegemonic, we do see ourselves as input-output systems in digestion as well as in cognition and education.

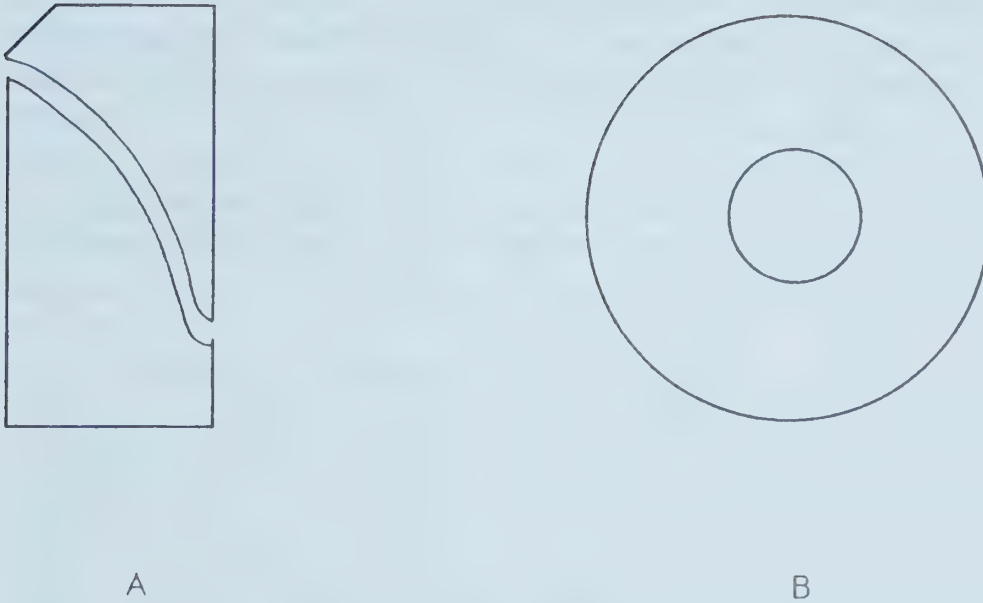


Figure 1. Cross sections of two topologically equivalent 3-D objects.

Question Three: An Alternative Ontology

An alternate ontology is implicit in the I-O postulate (conduit metaphor more pervasively) when it is realized that this postulate is compelling largely because, as suggested earlier, it helps us to re-pair the original *cut* made in the universe. As a device to *heal* the separated universe, the I-O postulate might be more of a technological fix than it is central to a *healthy* universe. In a sense we have become “addicted” to the fix only because we assume that the *natural* state of the universe is to be already cut (Toulmin, 1961). If this natural state is more a product of cultural-lingual circumstances than it is a reflection of any primal state, then a procedure for *bridging* separations would be artifactual at best and debilitating at worst (we would have a world of nothing but artifactual bridges). As an alternative, some attention might be given to a postulate that would not only have us refrain from implementing more cuts as an *automatic* response, but would have us oriented to the ongoing health of an originally given world: Nature would be framed as having an initial integrity not needing *integration*. For lack of a better term, I call this the *Wholeness Ontology* (WO).

WO presumes not only that the universe is already integral, but that wholeness in and of itself is a healthy state (Bertalanffy, 1968). Separating objects from the whole would be seen as an analytical act done by an observer. As observers (farmers, scientists, engineers, teachers, etc.) we have all separated objects. In fact, in this view, identifying objects at all is purely a descriptive act. To the extent that such descriptions destroy the original wholeness, they are necessarily invalid (e.g., diagnosing a child as “a math-phobic grade 4 student with an IQ score of 122, but with short attention span and problems with graphemic but not phonemic reversals, reading 3.2 years below grade level, yet with a self-esteem score in the 89th percentile, etc., etc.”). When are such diagnoses complete? How many more cuts are necessary until we can completely “understand” this “disabled learner”? What produced this state of ill health? How many bridges will have to be built so

that this state of disability can bridge itself? Will the child ever be able to crawl out from under the bridges, or does he become these bridges? Is there any child left, or has it become a complicated diagnostic reconstruction of cuts and bridges to span the cuts?

However, descriptions need not destroy the initial integrity. Indeed, descriptions may help us to uncover the phenomenon at a deeper level as in the work of Spencer-Brown (1972). But this will only happen in a conscious way if we are aware that our analyses are products of the frames that produce them. Perhaps a mathematical example is in order.

Although not commonly seen as such, mathematics itself is an example of the making of descriptions that, as creations of the human mind, enhance our understanding but that have no status beyond being creations of our frames. In contrast to this, mathematics in Greek times was seen as fundamentally grounded in *self-evident* truths (Euclid is a prime case). Such self-evidence was provided by the common sense of human experience. Each postulate of Euclid was, as it were, a device for cutting the universe into two parts; one that behaved according to the postulate, and the other that didn't. The part that didn't just didn't exist. Choosing a postulate as a way to cut the universe into two parts is precisely the process of making distinctions as proposed by Spencer-Brown (1972). The postulate as a distinction creates two states, the *marked* state and the *unmarked* state. The marked state is that defined by the postulate; the unmarked state is that excluded by the postulate. For a long time, it was believed that such postulates (the marked states) reflected the *nature of things*, the *nature of the universe*, the *self-evident truths of mathematics*. Thus the postulates as descriptions of the nature of things were seen as *reality* captured in logical form. The marked states captured by Euclid's postulates (Euclidean geometry) were thus *reified*. The unmarked states just didn't exist (non-Euclidean geometry). And indeed, for 2000 years, non-Euclidean geometry did not exist, at least not in the minds of people called geometers.⁸

Nowadays in mathematics, the arbitrariness of associating "reality" (common sense) with marked states is revealed as a choice of the mathematician. It is now widely realized that unmarked states can lead to the creation of mathematical systems just as logically valid as those manifested from marked states. Postulates, as choices made by a human, are thus nothing other than the choice of a preferred (self-evident) reality that is then disclosed by that postulate system. The ultimate practicality of mathematics, so eloquently described by Wigner, is a tribute not to the truth of the initial distinctions, but to the coherence of the human mind that chose those distinctions: Having chosen which reality to disclose, should we be amazed when we find that the mathematics thus created actually helps to interpret (disclose) the experiences we have chosen to realize? This is again an example of the power of frames to so powerfully reveal "truth" to the person wielding the frame. WO indicates that we ought not be amazed; surprised perhaps (at the wonderful coherence of being human), but not amazed. Amazement is likely due to believing in the separate existence of mind and reality (the separation ontology); when mind and reality (e.g., mathematics and experience) come together so articulately, we are amazed.

On the other hand, if mind and reality were always together (WO), then we ought not be amazed that they still seem together in our mathematical experience; rather, we may be a little surprised that despite our intricate and elaborate distinction making (our *construction* of mathematics) we have not violated the integrity of the universe (or *multiverse* if we prefer to think in alternative versa)⁹ beyond interpretation. From the perspective of WO, if we reify as reality the experiences disclosed by our chosen postulates, our minds may be caught in a Euclidean “mindjacket” too tight to encompass the universe.¹⁰

Question Four: An Alternative Postulate

While it would be appropriate to enter into the life world of Eastern cultures (Taoism, Zen, Shibusa, Wabi, etc.) to find a postulate resonating with WO, I have chosen to remain within the Western world view, and in doing so I am likely to fall prey to I-O frames implicit in Western languages. Nevertheless, I have chosen to frame my orientation with a set of distinctions that was not available in the East, at least not to the Ancients: The Second Law of Thermodynamics (popularly referred to as the Law of Entropy) that indicates that the “natural” order of the universe is slowly yet inevitably disintegrating (see Rifkin, 1981, for a readable review and Bateson, 1972, for interesting interpretations). If the concept of entropy had been part of the thinking of the Ancients of the East, they may have had second thoughts about existing in harmony with a reality (nature) that was supposedly slowly yet inevitably dissipating. Perhaps they would have been more interested in *enhancing* nature (but of course without violating her). Here in this unhistoric meeting place of East and West, a meeting place that never took place, I see a place for a postulate of enhancement without violation. And yet, taking entropy as a given, is there any hope for enhancement, let alone enhancement without violation? Consider these remarks from Weiner (1967):

But while the universe as a whole, if indeed there is a whole universe, tends to run down, there are local enclaves whose direction seems opposed to that of the universe at large and in which there is a limited and temporary tendency for organization to increase. (pp. 20-21)

Thus there is hope, at least in “local enclaves,” that coherence can be enhanced. Recent work with chemical systems has led to new understanding of the nature of such local enclaves, and I turn now to some of this work as it is significant to an alternate postulate of enhancement. In doing so I caution myself that this work is itself framed within the I-O postulate.

Order Through Fluctuations

The study of the *spontaneous* emergence of order in local enclaves has been motivated in part by the discovery in chemical systems of unexpected patterns in situations of turbulence, particularly in the pioneering research of Ilya Prigogine (1980) who received a Nobel Prize for his work in Dissipative Structures. The name itself suggests that as the given order dissipates (entropy), new structure emerges (enhancement).

Prigogine's study of the spontaneous emergence of new patterns has led him to see universality in the spontaneity of both human beings and the natural world in which they live. Prigogine and Stengers (1984) state it this way:

This leads to a new view of matter in which matter is no longer the passive substance described in the mechanistic world view but is associated with spontaneous activity. This change is so profound that ... we can really speak about a new dialogue with nature. (p. 9)

This "new *dialogue* of human beings with nature" is a special case of a wider dialogue within nature. This wider dialogue within nature is the setting for local enclaves. In general, local enclaves can be described as special kinds of bounded *open systems*. By this I refer to a system that dialogues, that is, "communicates" *within* its environment, and in this sense is *bounded* yet open to information. For example, in the domain of cognition, such systems could consist of the minds of students communicating within their surroundings (e.g., discussing with other students or with the teacher some aspect of a solution). Though such conversations could be described using the I-O frame, I offer an alternate postulate that may be more appropriate to the conversational setting.

Dissipative Structure theory tells us that of the three types of open systems: (a) those at-equilibrium, (b) those near-equilibrium, and (c) those far-from-equilibrium, only the third type leads *spontaneously* (Prigogine's term) to the emergence of new order. The other types may lead to order, but it will not be an order that emerges spontaneously. When systems propel themselves through reciprocal *recursion* to a far-from-equilibrium state they are subject to spontaneous, dramatic reorganizations of structure. The role of recursion is pervasive in the emergence of this order. Recursion takes the form of *cross-catalytic* and *auto-catalytic* perturbations that, in a compounding (nonlinear) way, drive a system to a highly sensitive state far-from-equilibrium. This is a local enclave, a state in which information not normally sensed can have dramatic (but unpredictable) effects on the new order that emerges. (Unfortunately there is not sufficient space to provide more detail here. For further discussion of Dissipative Structures in education, see Doll, 1986; Sawada & Caley, 1985; Sawada, 1986).

Conversation: An Alternate Postulate

As a paradigmatic embodiment of "dialogue within a local enclave," a *conversation* is a recursive system. The operation of recursion is its essence because it is through recursive interaction that participants in a conversation act as *contextual perturbations* on each other (rather than input into each other) to such a degree that the conversation as a system in its own right becomes sensitive to subtleties of information that recursively lead the conversation to even more subtle configurations far-from-equilibrium. Such a description would, for example, highlight the *immersion setting* for learning a second language rather than the *instructional strategies* themselves.

These kinds of conversational settings are local enclaves to the extent that they can maintain their recursive organization (Maturana & Varela, 1980, 1987; Varela, 1979; Zeleny, 1981). Although it may seem counterintui-

tive, within a conversational setting I take “reflection” as the maintenance of the organization throughout recursive interactions.¹¹ If enclaves are forced to take on imposed order, then they are forced back to equilibrium, which is the destruction of the enclave.

For example, when an outside “authority” figure (e.g., the principal) enters into the physical space of a lively student conversation, his or her mere presence is often enough of an interruptive perturbation that the conversation disintegrates into a mere *collection of individuals* who now seem just to be “standing around.” This would be an example of the destruction, albeit unintentional, of a local enclave; of driving the conversational setting to the equilibrium (entropic) state of a *collection of particles* that just happen to be there (the conversation no longer maintains itself).

The concept of *perturbation* as used above is critical in sensing the difference between the I-O postulate and the Conversation postulate. A conversation is a system of mutually interacting components. Each component (participant in a conversation) “perturbs” other components, not in the sense of “inputting” into other components, but in the sense of *disturbing their equilibrium through a change in the context*. If the perturbations build up recursively to a degree sufficient to drive the components (and possibly the conversation itself) far-from-equilibrium, a new dissipative structure may emerge in the form of new relations among components perhaps at a higher level of equilibrium (a quasi-steady state). The new relations are not in any sense “input”; they emerge as dissipative structures expressing a different, perhaps higher, level of relationship. We might say that the conversation has reached a new plane.

To illustrate these distinctions, consider the many debates that took place in the 1960s and 1970s concerning discovery teaching.¹² While no resolution to the claims and counter claims ever reached a final conclusion, there was one aspect concerning the nature of learning as “personally appropriated knowledge” that was quite controversial. It was claimed that such learning “belonged” to the student. It may be opportune to revive this claim in terms of the conversation postulate.

In discovery learning, information was not *given* (input) to the student; rather, the student was to be placed within a perplexing or ambiguous, or anomalous, or dissonant *setting* (a situation filled with rich perturbations) that required some resolution. In the process of resolving the problem, the student supposedly discovered (perhaps *created* is a better word) some mathematics. It seems to me there are parallels between the discovery learning versus rote learning issue and the conversation postulate versus the I-O postulate. The centrality of the process of perturbation in the conversation postulate is also foundational to the discovery learning dynamic in that the learner is not seen as a being who is just given information to be assimilated (input) so much as a being who is *immersed* in a setting full of perturbations. Generating a higher level of coherence in this situation would correspond to making a “discovery”; it would also correspond to the emergence of order in a *chaotic* situation far-from-equilibrium. In both views, the learner is undergoing a personally appropriated transformation, an example of order emerging within a perturbing context.

*A Mathematical Embodiment of Conversation*¹³

To this point in our discussion of reflection and recursion the Conversation postulate has been rather amorphous due in part to the limitations of ordinary language. To make these notions somewhat more explicit, as well as to more carefully contrast the Conversation postulate with the I-O postulate, let us consider three mathematical specifications of conversations as systems of recursive functions. Before doing so we need to clarify one item of notation. In indicating the simple sum of say three scalars a , b , and c we normally write $a+b+c$. In what follows, we use instead the more general notation $+/a,b,c$ in which the three scalars are considered a vector and the addition operation is then defined over the vector. This notation is due to Iverson (1962). Again, I must caution the reader that mathematics too is pervasively affected by the I-O frame.

Consider now a conversation between two participants A and B. Using the above vector notation, and taking the interaction (I) of the participants as the operation, a conversation C_n can be specified jointly as the “married” recursive functions:

$$A_n = I / A_{n-1}, A(A_{n-1}), A(B_{n-1}) \quad (1)$$

$$B_n = I / B_{n-1}, B(B_{n-1}), B(A_{n-1}) \quad (2)$$

In these functions, the conversation is assumed to “chunk” itself into episodes that can be considered as states of the conversation. C_n is the n^{th} state of the conversation while C_{n-1} is the state of the conversation prior to evolving to state C_n . Likewise A_n is the n^{th} state of participant A while A_{n-1} is the state of A prior to evolving to state A_n . Similar remarks hold for B. As well, no initial conditions have been specified because it is impossible to prespecify the original sources of conversations in nature. Some general notions can now be articulated more precisely:

1. A_n is recursively generated within the previous conversational episode C_{n-1} through the perturbational interaction I among A_{n-1} , $A(A_{n-1})$, and $A(B_{n-1})$.

2. $A(A_{n-1})$ is a *composite function* of A with *itself*. As a composite function of itself in a previous episode, A is experiencing itself, A_{n-1} , not so much as an input, but as a *memory*.¹⁴ For example, A could be having “second thoughts” or even arguing with himself or herself. Indeed, mathematically speaking, A_{n-1} is even called an “argument” of A. It is a case of self-argument. As such it may be interpreted as a special case of self-reference, namely *self-awareness*. In other words, in a conversation, self-awareness has a precise specification: It is *self-perturbation* as an argument in a composite function within a recursive interaction. It is a way of experiencing one’s experiences by activating memory through self-conversation. In this sense, self-awareness is not so much something that is *input* from the outside as it is the re-cognition of self as recursively present in one’s memory.

3. Likewise, $A(B_{n-1})$, as a composite function, is a realization of “other awareness,” i.e., B as a perturbation for A. Similarly, $B(A_{n-1})$ is B’s awareness of A, in a sense B remembering A from the previous conversational episode. Other awareness is thus *cross-perturbation*. Cross-perturbation is the defining character of conversation as a “marriage” of recursive functions. That is, the “married” aspect of the recursion occurs via the presence

of $A(B_{n-1})$ in equation (1) and $B(A_{n-1})$ in equation (2). Because B_{n-1} in $A(B_{n-1})$ perturbs A and because A_{n-1} in $B(A_{n-1})$ perturbs B , the two functions are explicitly interdependent. It is likely bad enough that in a marriage each partner “perturbs” the other; if each were to directly *input* into each other (or try to) it is not likely that the marriage would last long. More significantly, the “marriage” is a new suprasystem which *is* the *conversation* itself with participants A and B as subsystems (components). The “married” terminology is also used by Hofstadter (1980).

4. Should the cross-perturbational components be trivial (as, for example when A and B are so disinterested they drop out of the conversation or out of the marriage), this can be registered by “dropping” $A(B_{n-1})$ and $B(A_{n-1})$ giving:

$$A_n = I / A_{n-1}, A(A_{n-1}) \quad (3)$$

$$B_n = I / B_{n-1}, B(B_{n-1}) \quad (4)$$

In these “truncated” functions, cross-perturbation is absent and as such the “marriage” is dissolved; the conversation as a suprasystem is no more. We have only two independent recursive functions, that is, participants interested only in themselves (conversational monads). Typically, this would describe a conversation where no one is listening, although of course people may appear as if they were listening. Such conversations rarely lead anywhere. Sometimes teachers talk to children as if listening played no part in the conversation. These truncated equations also describe what happens in a mutually boring conversation: It *self-destructs*. No higher level unity can emerge at the dyadic level; as a conversational dyad, this truncated system is *at-equilibrium*. At the monad level, however, it could reach far-from-equilibrium status.

5. As monads, the equations show that A and B are both self-aware (because of the self-perturbational component). In other words, although they are no longer participants in a conversation with each other (marriage dissolved; no one listening) at the monadic level, they are still in conversation with themselves (perhaps even talking out loud; or, in a problems solving context, thinking aloud to themselves). Thus self-awareness in these equations is precisely “having a conversation with oneself.” Of course since the self-perturbational component is also present in equations (1) and (2), self-awareness is an inherent *subproperty* of having conversations with others. Moreover, such self-awareness may be heightened by being immersed in other-awareness.

6. Further truncation leads to:

$$A_n = I / A_{n-1} \quad (5)$$

$$B_n = I / B_{n-1} \quad (6)$$

In these equations there is no perturbation whatsoever, neither self- nor cross-perturbation, since there are no longer composite functions in the model. Instead, we have two individual selves, two independent entities separated from each other. Each is what Ashby (1956) tellingly calls a “regular, determinate, and reproducible” *machine*. They are precisely the kind of entity that is appropriate to what was earlier called the “separation ontology.” That is, the I-O postulate is what is left when perturbation is completely truncated from the mathematical specification of conversation:

We are left with an I-O machine *separated* both from itself (no self awareness) and from its environment (no other awareness). For such a machine to reflect upon itself, it indeed must step outside itself and become input to itself. It is an *object* of the kind often created and celebrated in the separation ontology.

7. If one were to program (5) and (6) for computer simulation, the programs would be of the type that *call themselves*. In contrast, if systems (1) and (2) or systems (3) and (4) were programmed, these would be programs that not only call themselves, but also *modify* themselves (self- and other-awareness through self- and cross-perturbation). As such, these *self modifying* programs could lead to unexpected patterns (insights) that are *not* determined by the initial parameter settings. There is a sense of *spontaneity* in such programs which, as Hofstadter (1980) says:

suggests that suitably complicated recursive systems might be strong enough to break out of any predetermined patterns. [Ashby's "regular, determinate, and reproducible" machines] ... Instead of just considering programs composed of procedures which can recursively *call* themselves, why not get really sophisticated and invent programs which can *modify* themselves—programs which can act on programs, extending them, improving on them, generalizing them, fixing them, and so? This kind of "tangled recursion" probably lies at the heart of intelligence. (p. 152)¹⁵

Hofstadter urges us to "get really sophisticated and invent programs which can *modify* themselves." Although his advice is well taken, we should also recognize that, if we take the conversational postulate seriously, then as cognitive systems in conversation we *are* "tangled linguistic recursion."

8. Self- and cross-perturbational processes are central in the mathematical specification in distinguishing the Conversation postulate from the I-O postulate. These two processes are the conversational isomorphs of Prigogine's (1980) "auto-catalysis" and "cross-catalysis", which are so important in catalyzing the *nonlinear* forces that drive a system far-from-equilibrium. Isomorphically, self- and cross-perturbation play the same role in conversational systems.

9. The mathematical embodiment presented here is rudimentary; at best it is only suggestive. For example, the specification as it stands is not *computable* in the sense of Davis (1974). Nonetheless, the models might be helpful in bringing a degree of specificity to the discussion.¹⁶

Question Five: What Meaning Do Reflection and Recursion Have in the Conversational Postulate?

As has been noted, the self- and cross-perturbations in the recursive interactions of a conversational system generate a far-from-equilibrium enclave in which new order often emerges as dissipative structures. Within this enclave, reflection is simultaneously a process and a product. Let me try to be clearer about this. As a product, reflection can be specified as the new order that emerges within a conversation in just such far-from-equilibrium enclaves. In other words, reflection is generated by the recursive self- and cross-perturbational processes: As the recursion drives the conversation to states that are farther and farther from equilibrium, each state is an enclave in which new

order may emerge in the form of new relations that, by their coherence maintain and stabilize the new quasi-steady state.

Simultaneously, as an ongoing process, reflection is the maintenance of the new order in the form of a *network of relations* that define the new order at a higher level. Thus reflection is simultaneously the new order and the maintenance of the new order.

Even a single cycle of recursion produces a setting for reflection; however, such a setting is likely to be “at- or near-equilibrium” and is therefore not likely to spontaneously give rise to any new order. Most conversations in school, since they are predetermined by a preset agenda (e.g., a teacher-specified objective), are of this kind. However, if the recursion is allowed to drive the conversation far from its starting point, the more likely it is to become an enclave in which new order will emerge as reflection. Unfortunately, in many classrooms, and particularly those dominated by the conduit metaphor, such far-from-equilibrium enclaves, if realized, would likely be seen as “off task” and therefore quickly and decisively brought back to equilibrium in a controlled if not hostile fashion. Formal schooling, in keeping students tightly focused on predetermined objectives (input), likely prevents them from actualizing spontaneous far-from-equilibrium reflections. The coming of the National Council Teachers of Mathematics (NCTM, 1989) *Standards*, with emphasis on communication and problem solving, may provide impetus to allow something like the conversational postulate to be seen as a possible alternative to the I-O frame.¹⁷

As an illustration of near-equilibrium reflection, Bateson (1972) spoke of the punctuations that participants use in an ongoing conversations. For Bateson, these punctuations were sources of what he called second-level learnings (we would call them reflections) that establish particular personality characteristics. For example, in a dyadic conversation, if Person A punctuates the conversation so that Person B is always responding to Person A’s contributions then Person B might well emerge, over a period of time [a period of recursions], with a certain dependency. (Some teachers, particularly those who wish to keep a tight “executive” control on all verbal interaction, punctuate their conversation with students in just this manner.) Such punctuations, experienced daily as linear repetitive recursions, are eventually *reflected* in a new order of personality characteristics (dependency); in turn and over time, this new order will be reflected in a higher level social order (a classroom “climate”) in which students rarely show initiative. They have been programmed, so to speak. It could be said that a new (meta) level of “law and order” in the classroom has emerged from the conversations. This kind of meta-order has another name: the hidden agenda or the hidden curriculum. Other styles of punctuation could lead to different personality characteristics (e.g., respect for others) and a very different climate (e.g., a place where risk-taking is supported).¹⁸

Question Six: A Complementarity

If the previous five questions have been adequately answered, though I fear they have not, then it should be reasonable that reflection and recursion imply that a system must “step outside itself” only under the I-O postulate.

Under the Conversation postulate, reflection and recursion are both *internal* operations, with reflection being generated through recursion. Each level of reflection emerges as the new order in the system at that level. In this way reflection and recursion are necessarily *coexistent*.

What is remarkable is that the exact relationship between the inside experience and the outside experience obtains also between recursion and reflection themselves: Recursion generates the processes that internally drive the system to a far-from-equilibrium enclave in which new order emerges as a network of reflection. Such a network becomes part of the enclave that supports the recursion that generated the network. As a product, such reflection can be described by an observer as “output.” The ongoing development of such a system, that is, its history as a self-generating network of recursive processes is as a *complementarity* of reflection and recursion. Varela (1979) has developed a mathematical way of specifying such complementarities in which a higher level system (the ongoing development) is produced from the relations of two interdependent lower level systems wherein one system generates the processes (e.g., recursion) that produce the other (e.g., reflection). In this sense, reflection and recursion form a complementarity in which recursion generates the processes that produce new order (reflection) captured as a network of relations (the complementarity) that supports and maintains the recursion that generates it. Using the symbol * (taken from Varela, 1979) this complementarity can be denoted as follows:

* = network / (reflection / recursion).

Similarly perturbation and transformation, as discussed earlier, form a conversational complementarity:

* = conversation / (transformation / perturbation).

Closing Words

I have given a brief outline of an alternate view of reflection and recursion based on the Conversation postulate and have contrasted this view with that based on the I-O postulate (conduit metaphor). Each postulate brings forth different yet non-independent worlds. Together they form a complementarity that I suggest provides both a more comprehensive and a more authentic disclosure of education.

Notes

1. The work reported here was sponsored in part by a research grant from SARAC of the University of Alberta. I wish also to acknowledge the many conversations with Alton Olson and Tom Kieren whose insights were invaluable..
2. The work of Harry Garfinkle at the University of Alberta is particularly insightful in this regard. He has historically traced major shifts in Western consciousness since 1425 and places reflection as a major form of consciousness emerging in the period 1575-1650, making it a rather dated form of cultural/cognitive awareness.
3. I have had a number of people read this article before it was accepted for publication. While some reactions were supportive and encouraging, others were almost antagonistic. These differences in interpretation are in Schön's terms a result of frame conflict. If frame conflict is immune to the presentation of “facts” then it is most difficult to “improve” the article by marshalling further evidence. The problem is one of the barriers to communication and in this sense this article is likely to be a joy to read or a frustrating experience depending on the degree of frame conflict experienced by the reader.

4. As the ideas in this article began to become clearer to me over a number of years, I began to consider the possibility of putting them on paper (conduit metaphor?). However, the more I tried, the harder it got (a case of frame conflict?). As I write this article I am trying to speak across the chasm without building bridges (conduit?). I may be failing miserably as I get entangled in the very dilemma I am trying to clarify. Could it be otherwise?
5. At the risk of overstatement, the problem of a “false” ontology brings to mind the revolutionary developments in early 19th century geometry in which Euclid’s “obvious” postulate (the now celebrated “Fifth”) was seriously questioned in terms of its uniqueness in accounting for parallelism. As mathematicians slowly and painfully and somewhat blindly came to question their own commonsense as well as that of their colleagues, alternate contexts (ontologies) from which to construe parallelism gave rise to alternate postulates that eventually were seen as appropriate as Euclid’s. In a sense, Euclidean geometry was “self-evident” much as the conduit metaphor is today.
6. The notion of *repair* is itself interesting. Literally it means “to pair again,” that is to put back together the two parts of a pair—to repair. As a notion of “fixing” things our current notion of repair is traceable to the original “ontological cut.”
7. Darcy and Jayaratna (1985, p. 85) express this point rather succinctly: “The partitioning of any world view into the two components of: ‘the system of interest’ and ‘the attendant environment’ necessarily requires the imposition of some arbitrary separation. Within this artificial, intellectual (and therefore invisible) boundary, the search is then directed, usually for solutions to the problems as they are now constrained to appear.”
8. Penrose (1989, p. 204) makes a similar point: “The fact that Euclidean geometry seems so accurately to reflect the structure of ‘space’ of our world has fooled us (or our ancestors!) into thinking that this geometry is a logical necessity, or into thinking that we have an innate *a priori* intuitive grasp that Euclidean geometry *must* apply to the world in which we live [emphasis in original].” Self-evident truths can be very devilish indeed.
9. Maturana and Varela (1980) in their cosmology depict the “universe” as but one manifestation of *multiversa*.
10. The British physicist Bohm (1980) warns: “This sort of ability of man to separate himself from his environment and to divide and apportion things ultimately led to a wide range of negative and descriptive results, because man lost awareness of what he was doing and thus extended the process of division beyond the limits within which it works properly. In essence, the process of division is a way of *thinking about things* [emphasis in original] that is convenient and useful mainly in the domain of practical, technical and functional activities.... Being guided by a fragmentary self-world view, man then acts in such a way as to try to break himself and the worlds up, so that all seems to correspond to his way of thinking. Man thus obtains an apparent proof of the correctness of his fragmentary self-world view though, of course, he overlooks the fact that it is he himself, acting according to his mode of thought, who has brought about the fragmentation that now seems to have an autonomous existence independent of his will and of his desire” (pp. 2-3).
11. Reflections in this sense are the contextual perturbations that together are the immersion setting of a conversation. Conversations taken in this way are their own context. Reflection, as context to conversation as well as being conversation *per se*, maintains the conversation through perturbational action. Often, of course, the maintenance is of a negative sort, for example, an authoritative demand from outside, resulting in the destruction of the conversation. More on this later.
12. Alton Olson (personal communication).
13. The development to be presented here is based on Sawada and Pothier (1986).
14. For a discussion of memory compatible with the Conversational postulate see Witte, Everett-Turner, and Sawada (1991).
15. It is interesting to note that despite Hofstadter’s rather revolutionary suggestions, he still talks of “*improving* on them, *generalizing* them, *fixing* them” indicating that even radical thinkers like Hofstadter are still caught in a language appropriate to the I-O postulate. The hegemony of the conduit metaphor is pervasive indeed.
16. The fascinating book by physicist-mathematician Penrose (1989) provides a penetrating discussion of the limits and possibilities of computability in understanding as well as explaining communication.
17. Indeed, I would suggest that if communicative processes are consciously or unconsciously “conducted” within the conduit metaphor, the *Standards* are likely to be another in a series of small technical changes.

18. Alton Olson (personal communication). Furthermore, in the field of drama, the work of Herman (1991, p. 97) regarding turn-taking in the context of the stage ("dramatic dialogue") reveals an interesting case of communicative punctuation: "In drama, not only the identity of participants, and the roles they adopt, but also who speaks to whom, who is not spoken to, the actual path of interaction and its outcome, the relative quantities of speech apportioned to characters, manner and style of speech, alignments and groupings of characters in the exercise of speech, and power relations established interactively through the manipulation of the speech resource and its alternation are as significant as what is spoken."

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The Transformation of Curricular Knowledge

School curriculum appears to be evolving in the direction of increased complexity. The number of stakeholder groups in the curriculum decision making process is leading to competing curricular materials, often with conflicting viewpoints on what should be emphasized. The purpose of the present discussion is to identify a number of possible epistemological perspectives that can be taken on the changing nature of curricular knowledge in science and to consider some of the normative characteristics of each. The varieties of knowledge and value perspectives associated with each inform teachers and students how they are expected to think about the subject, the kinds of knowledge that are to be preferred, and to what kinds of contexts the subject can be expected to apply. An epistemological triad of resultant knowledge, procedural knowledge, and required action conceptualizes the relationship among the components of curricular discourse.

School curriculum appears to be evolving in the direction of increased complexity. Competing curricular materials, each with a specific orientation, for example, process-approach science, environmental science, general science, integrated science, science and society, science and technology, have emerged in many parts of the world, with no particular orientation emerging as a necessary orientation. The purpose of the present discussion is to identify a number of possible epistemological perspectives that can be taken on the changing nature of curricular knowledge in science and to consider some of the normative characteristics of each. The proposition that any perspective that is presented on what is known reflects the values orientation of its developers toward that domain of knowledge is explored in the context of the new curricular realities.

The question of what constitutes curricular knowledge in science is becoming more and more intertwined with the practicalities of designing a curriculum that meets with both professional and public acceptance. In earlier times curriculum design was generally left to subject matter experts and textbook writers. In such a context, questions involving the nature of curricular knowledge were rarely regarded as matters for debate. Relationships between school knowledge and various subject fields tended to be viewed as straightforward and by and large self-evident by both teachers and the public. The large funded science curriculum projects of the 1960s—PSSC Physics, CHEM Study, and BSCS Biology illustrate this point of view.

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the public. The large funded science curriculum projects of the 1960s—PSSC Physics, CHEM Study, and BSCS Biology illustrate this point of view.

The situation is now changing rather dramatically. The level of public scrutiny of school curricula is increasing and the involvement of numerous special interest groups as stakeholders in the curriculum decision making process is leading to a variety of often conflicting viewpoints on what should be emphasized (Fensham, 1988). This multiplicity of views and preferences is compounded by the rapid advances in knowledge that characterize numerous subject fields and the emergence of new specializations and approaches to inquiry. The scientific and technological fields are a case in point and will provide the specific examples developed in this discussion.

The proliferation of points of view about what to include in contemporary science curriculum is taking place against a backdrop of concern, particularly in North America, that a serious quality problem seems to exist in science education. The so-called hard sciences of physics and chemistry are often singled out. Enrollment data indicate that many students opt out of science and mathematics courses at the first opportunity (Science Council of Canada, 1984). International comparative studies such as those sponsored by the International Association for the Evaluation of Educational Achievement (Connelly, Crocker, & Kass, 1989) reveal that North American high school students are often clustered in the lower third of average test scores in physics, chemistry, and biology.

Many factors affect both educational outcomes and achievement test scores. To discuss such factors here would be a digression from the major purpose of examining the epistemological nature of curricular knowledge as it is reflected in the sciences. It is also not the purpose to recapitulate and summarize here the large body of scholarly work that has been done in the past 40 years or so in the field of curriculum studies. This work is well documented in the literature. Numerous models have been developed to characterize the processes of curriculum development, implementation, and evaluation and to inform practice in these areas.

Discourse on the nature of the epistemological knowledge forms to be represented in school curricula has not been extensive. School curricula are most often formal curricula with explicitly stated goals, objectives, topics, and skills. In today's education setting, competition for a place in the school curriculum takes place within the context of multiple differing perspectives on what would constitute an appropriate basis for choice. Theoretical treatments of the nature of curricular knowledge, on the other hand, tend to approach the question from one preferred epistemological perspective (Aikenhead & Fleming, 1975; Apple, 1979) or point of view. While such discussions provide additional perspectives to be considered, the problem of how to organize and interrelate the various perspectives remains.

It is suggested that numerous varieties of knowledge and the value perspectives associated with each interact both at the explicit and implicit normative levels in any given curriculum and that these messages are communicated to both the teacher and the student. Often such impressions outlast the recollections of the specific facts and principles. These messages inform teachers and students how they are expected to think about the

subject, about what kinds of knowledge are to be preferred, and to what kinds of contexts the subject can be expected to apply.

The discussion identifies nine knowledge forms that have been found to coexist in science curriculum discourse. The normative nature of each is discussed. The emergence of awareness of these knowledge forms in the course of a secondary school science curriculum development project (Jenkins, 1987) is described. Each illustrates the epistemological values held by a particular interest group. These interest groups are portrayed as emphasizing particular kinds of knowledge. The preferred type of knowledge dominates the prime space of the textbooks and instructional materials that are selected and is also the kind of knowledge that is tested. Each perspective represents a different starting point for approaching the nature of science and can lead to curricula that are very different from each other. Just as it is possible for an individual to hold a variety of perspectives on the nature of knowledge, including knowledge in the scientific and technological realm, curriculum can also reflect a multiplicity of perspectives in a coherent organizational framework. It is argued that students should learn explicitly within the sanctions of schooling that there are different varieties of scientific and technological knowledge and that different value perspectives on their role in science-related social and environmental issues can be held.

Curricular Knowledge as Formalized Knowledge

The transformation of scientific knowledge from its doing phases to its codified and reconstructed forms for purposes of communication to others can be summarized as in Figure 1.

The process of codification, standardization, and transmission of scientific knowledge involves many modifications along the way (Ravetz, 1971). Both explicit and implicit criteria for selection and interpretation operate at each step. What is included, what is omitted, and what is emphasized is a function of the orientation of the person making the decision toward the knowledge. The subtle yet powerful influences of human value orientations on the nature and creation of scientific knowledge itself have been widely discussed since the appearance of Kuhn's essay on "The Structure of Scientific Revolutions" (Kuhn, 1970). At each step in the communication process

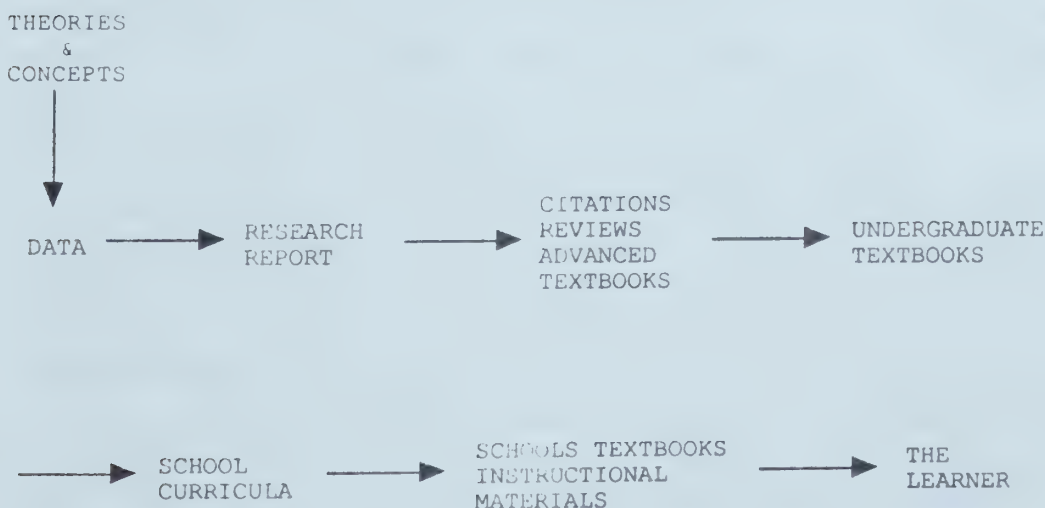


Figure 1. Steps in the standardization of scientific knowledge.

other people more removed from the work engage in decisions affecting its portrayal and place in the whole. Simplification and generalization take place as the material is restated and reorganized, with the inevitable smoothing out of detail and variability. This context stripping and reshaping results eventually in the public view of the scientific enterprise that portrays its development as proceeding in an orderly and linear way to the current organization of standardized facts and principles. The task for the teacher then becomes one of transmitting this body of standardized knowledge that in some sense exists “out there.” The main job of the student is to assimilate those particular bits and pieces, problems and examples that are set out in the curriculum of the day (Stake & Easley, 1978; Weiss, 1978). The job of interpretation, of what the concept or fact means or counts for within some conceptual framework or view of knowledge, is either left to the student or discussed in terms of a small number of carefully preselected examples or situations that reflect and reinforce the preferred orientation to knowledge presented in the curriculum.

It needs to be recognized that this process of selection and streamlining has the (perhaps unintended) effect of closing off the subject for some students. The point made by Weisskopf (1976) with respect to physics also applies to chemistry, namely that it is considered inhuman by many students because of its abstract and symbolic concepts that deal with matters under conditions far removed from the human environment and direct human experience. The incompatibility of the picture of science presented in school curricula with the messages received by students from other sources, whether they be the popular media, magazines, or books like Hawking’s *A Brief History of Time* (1988) has not escaped the more reflective and well informed of our students.

The nature of the transformations that yield the formalized knowledge of school and university curricula needs to be made explicit to curriculum developers, textbook writers, teachers, and students. Each requires some understanding of this process in order to form a realistic picture of what kind of knowledge one is studying. When these realizations first emerge, some students may be inclined to reject formalized knowledge as being in some sense invalid. From a pedagogic perspective, however, understanding that formal knowledge reflects a high degree of publicly held consensus about what is important in the subject is an insight that may help both the teacher and the student to approach learning in a more productive way.

Normative Perspectives on Knowledge in Science

High school represents the last of formalized science study for approximately four out of five young persons. It is therefore of some importance that school curricula introduce students to the idea of different varieties of knowledge within science and the idea that different value positions about the nature and worth of different kinds of scientific knowledge are held within scientific discourse as well as in science textbooks and classroom discussion.

The pervasiveness of normative elements about the nature of science in science textbooks has been made explicit by Factor and Kooser (1981). Perhaps as a reaction to earlier aggregations of descriptive detail, the science

curricula of the 1960s gave particular value to theoretical knowledge. A number of current curricula, for example, *STSC Chemistry* (Jenkins et al., 1989), *Science Plus* (Atlantic Science Curriculum Project, 1990) place high value on empirical and applicational knowledge. While different textbooks in a field may reflect somewhat different dominant perspectives on the nature of knowledge in the field, it must be remembered that the student is typically exposed to only *one* of these.

How, then, can knowledge in science be viewed in order to present to learners a coherent portrayal of its interactions? The following section presents a set of *nine* knowledge types and some of the different epistemological goals and values that may be ascribed to each. Subsequent sections articulate their influences on what impressions students and teachers may generate about the nature of the subject, the kinds of learnings that are valued, and the kinds of intellectual problems that may emerge when different types of knowledge are inadequately differentiated.

Table 1 presents a set of possible normative perspectives on the nature of knowledge in science. Each perspective, although interacting with one or more others, informs students and teachers about how they are expected to think about the subject, about what kinds of knowledge are to be preferred,

Table 1
Possible Normative Perspectives on the Nature of Knowledge in Science

A. THEORETICAL	- Values theoretical knowledge and theoretical ways of knowing. - Seeks ever greater inclusiveness and predictive power in theory.
B. EMPIRICAL	- Values knowledge gained by empirical means: observations, experimentation, measurement, etc. - Seeks data.
C. APPLICATIONAL	- Values practical and instrumental knowledge and the gaining of knowledge in applied contexts. - Seeks ways of using knowledge, functional knowledge.
D. METHODOLOGICAL	- Values the processes and methods of gaining knowledge. - Seeks problems to solve, establishes criteria for reliability and generalizability.
E. EPISTEMOLOGICAL	- Values knowledge of the limits and validity of knowledge claims. - Seeks to identify underlying assumptions of knowledge claims.
F. SOCIAL RECONSTRUCTIONIST	- Values social, political and economic components of knowledge, social action/reflection. - Seeks emancipatory change, understanding of sociopolitical contexts, and uses of knowledge.
G. PSYCHOLOGICAL	- Values knowledge meaningful to the individual as an active participant in constructing these meanings. - Seeks relevant knowledge, personal knowledge.
H. PEDAGOGICAL	- Values effective and efficient ways of transmitting knowledge. - Seeks to develop literacy, standardization of knowledge.
I. HISTORICAL	- Values developmental characteristics of knowledge over time. - Seeks retrospective understanding of the origin and impact of ideas.

and to what kinds of contexts the substantive and methodological aspects of the subject can be expected to apply. One can ask for each perspective: What kind of knowledge is produced, and how is it valued?

A. Theoretical Knowledge

If current textbooks are any indication, this is the kind of knowledge valued above all else in the sciences. Indeed, Popper (1959) asserts that the empirical sciences are systems of theories. What is meant by theory, and where does theory development begin relative to human experiences and observations (Bradley, 1975) are questions not often addressed in school science courses.

Perhaps in part because theory in chemistry and biology is not nearly as extensively examined in its philosophical foundations as is theory in physics, the complex roles and functions of different kinds of theory in these sciences can become troublesome to students. Part of the puzzlement may be attributed to the tendency for textbooks to ignore such problems. Theory is typically presented as clear-cut and self-evident in its properties as a kind of scientific knowledge. Discipline related and specific problem contexts, if these are considered at all, tend to be viewed as a backdrop for how the theoretical ideas are played out in nature rather than as interacting in a profound way in establishing what the theoretical ideas mean (Kuhn, 1970).

A closer examination of theoretical knowledge in the sciences reveals that the notion of "theory" is itself complex. Examination of science textbooks reveals at least six different ways in which the idea of "theory" is involved.

1. *Grand theory.* This kind of theory, for example, structure of matter, atomic theory, thermodynamics, is concerned with broad explanatory systems. While the context in which the ideas and relationships are used in different branches of science may differ, the desirable attributes of such theory are often implicitly accepted as being the same as in physics, that is, ever greater inclusiveness and predictive power. Individual descriptive contexts are stripped to yield mathematical and symbolic representations wherever possible. Questions having to do with the functions and desirable attributes of such theory within the contexts studied are rarely considered, with the result that students develop little sense of what is involved in formulating a scientific explanation in a specific field.

In the field of chemistry, Hammond and Nyholm (1971) argue that while directed explorations are grounded in theoretical pictures,

we must recognize that the focus of attention on a single model may seriously inhibit chemical advances. It has been said, and not without a grain of truth, that the factor which distinguishes a chemist from a physicist is that the former argues from 100 weak facts, whereas the latter argues from one strong fact. Without pausing to comment critically on the risks involved in placing too much reliance on one so-called "strong fact," we must concede that chemistry may be a less straightforward subject than physics. The ultimate molecular properties are inferred from indirect measurements, so evidence from many different sources is essential. The emphasis on a single model, may, in fact, distract an investigator from achieving his goal of building better models for molecular behavior. (p.8)

2. *Theory as key constructs* (or concepts), for example, chemical bond, acid. Fensham's discussion of the properties of scientific concepts in terms of intention and extension (Fensham, 1975) is useful here. This is the level at which much of what is conventionally viewed as science is grounded both in its pattern of inquiry and its substantive outcomes. This is also the level at which theoretical ambiguities, for example, what is an acid? and conventions, for example, current flow versus movement of charges, complicate the task of attaching some type of meaning to the theoretical terms.

3. *Theory as prediction/explanation of observation*, for example, the various acid-base theories, types of chemical reaction mechanisms. Much of laboratory work is directed at such a notion of theory. Indeed, the laboratory experiment itself may be viewed as a kind of theoretical entity. Patterns of observation provide meaning both in the sense of extension, that is, the set of objects or events the term denotes and intention, that is, the property or characteristics that is the criterial attribute.

The basic assumption in many science courses is that the students understand what scientific phenomena are. The science curriculum merely provides the explanations. The past 15 years of work on constructivist science learning and teaching (Fensham, 1988; Osborne & Freyberg, 1985; Pines & West, 1985) suggests that the teaching/learning situation is far more complex in its outcomes than has been envisaged. The inability of students to adequately differentiate the theoretical terms from the other kinds of words used (Lemke, 1990) may be attributed to insufficient experience with the content-specific, knowledge-rich nature of laboratory problem solving in science.

4. *Theory as revealed in principles*, for example, Avogadro's hypothesis, "survival of the fittest." Terms such as principle, hypothesis, theory and law are often used loosely and perhaps even interchangeably in scientific discourse. While it may be clear to the textbook writer, curriculum developer, or teacher what these terms mean to them personally, the student may not be able to quickly distinguish this type of theoretical statement from others. The notion of theory as an "unproven idea" is also commonplace in ordinary discourse.

5. *Theories as idealizations*, for example, ideal gas law. Relationships such as the above, which are not universal but idealized reconstructions that come complete with assumptions and limiting conditions, hold a particular place in science. Such theories are not the same kind of logical, or indeed practical, entities as, for example, grand theory.

6. *Theories as models*, for example, electron pair repulsion theory. Correlation between a prior theory and experimental results forms an integral part of science. However, the value of simple and easily used models for appropriate tasks, for example, use of the above model to predict shapes of selected molecules, needs to be placed in context. Such model building helps a great deal in stimulating new experiments. The transient character of many such models is an important aspect of the interaction between theory and experiment in science.

The above relatively lengthy treatment of the varieties of theory in science is intended as illustrative of the broad knowledge category of

“theoretical” knowledge. Consideration of the sense in which each may be viewed as normative within the discipline, within the curriculum, and within instruction requires further analysis.

B. Empirical Knowledge

Here we consider the nature and value placed on knowledge gained by observation, experiment, and measurement. What constitutes scientific data, and on what criteria does one judge its worth? How do the varieties of scientific data pertain to scientific theory?

The science teacher, like the scientist, may experience certain scientific phenomena over and over again in the course of her or his science lessons. The student, on the other hand, may experience the same phenomenon only once, if at all. The complexity of separating out the “scientific observation” from the undifferentiated mass of sense data that the student assimilates is, it is suggested, severely underestimated (Fensham & Kass, 1988). It is also crucial to developing a sense of what is meant by a scientific event (Bhaskar, 1975). As an illustration, it may be difficult for students to understand that even though one can calculate the mass of an electron from its charge to mass ratio and the Millikan oil drop experiment, it is quite another thing to treat it conceptually in the same way as, say, the density of copper.

Several kinds of scientific data may be identified:

1. Results of key experiments that led to advances in theory building and theory validation, for example, Rutherford’s alpha scattering. As pointed out by Kuhn (1970) part of the value of such data lies in the historical and/or standardized knowledge realm. Any arbitrarily selected example or instance is not suitable here. It needs to be *the* particular historical one in order to be a part of the shared paradigm of science.
2. Key experiments or observations with implications for theory revision. This includes experiments that have yielded the unexpected, for example, the demise of the idea of the so-called *inert* gases.
3. Normal science—the mass production of scientific knowledge. The results turn out more or less as predicted and any of a range of examples will do.
4. Tricky practical/applied problems, for example, catalysis. Not all common or well-documented scientific observations have a well-understood explanation.
5. Data related to the development and availability of specific instrumentation, for example, spectroscopic techniques, computers. This type of data simply did not exist earlier.

The value placed on data, particularly data experienced by the student is highly problematic in science curricula. In addition to the complex inter-relationships with theoretical knowledge, the everyday language of description used in conjunction with scientific data conveys its own set of images. The widespread use of particular adjectives to denote colors is a case in point. Chlorine gas is “greenish yellow,” litmus is “red” while phenolphthalein is “pink,” and so forth. The student’s sense perceptions of the colors may be quite different from the formalized descriptions that are learned.

C. Applicational Knowledge

This type of knowledge places high value on the practical usefulness of knowledge in real contexts and its worth is often contrasted with theoretical knowledge in this regard. The translation of theoretical knowledge to a form suitable for solving particular problems or meeting particular goals may itself be complex. Practical problems typically involve interactions among a much larger number of variables than found in theory-directed problem solving situations. After virtual disappearance in many of the science curricula of the 1960s and 1970s, applied chemistry is slowly being reintroduced in a number of recent school textbooks (Jenkins et al., 1989; Atlantic Science Curriculum Project, 1990).

D. Methodological or Procedural Knowledge

The knowledge inherent in mastery of the techniques and procedures employed in a branch of science is an integral part of that field. Such knowledge is at best only partially described by phrases such as “the scientific method” or “the process of science.” As an illustration, the procedural knowledge inherent in knowing *how* and *when* to do a redox titration is *not* the same as knowledge of the generic methods of science. As noted earlier, problem solving in chemistry tends to be more content-specific than in physics and the resulting solutions more localized in their range of application. Casting chemical problems into forms that are potentially solvable and establishing appropriate criteria for reliability and generalizability are a function of ingenuity and practical skill as much as they are application of broad algorithms. When one examines what chemists *do*, the listing of procedures and/or techniques is relatively brief (Fensham, 1983).

The above four varieties of knowledge together form the group that has dominated the sciences and science curricula to date. The five kinds of knowledge to be enumerated in the following sections are more recent in their emergence as curriculum-related perspectives to be taken on knowledge in science. Given the large amount of knowledge in each of the above four types that is available today relative to the amount that can be included in any one curriculum, the value of the kinds of knowledge now outlined may also reside in their usefulness in providing starting points for establishing selection criteria for such inclusion.

E. Epistemological Knowledge Perspectives

The present discussion may be viewed as an exercise in epistemological knowledge. The goal is to identify underlying assumptions of knowledge claims and to develop understanding of the range of applicability, limits, and validity of that which is presented as knowledge in a field. Matters to be considered include what constitutes logic in scientific reasoning, what are the varieties of scientific argument, for example, symbolic, mathematical, and how are these assessed? The need for this type of knowledge to be made explicit in science teaching is stressed by Desautels (1982), who refers to it as a critical view of knowledge.

In the realm of chemistry, students can easily leave their high school courses with impressions such as: all chemical reactions occur very quickly,

all chemical reactions go to completion, all acids are liquids, and other assorted misconceptions. Teachers tend to present only positive exemplars, that is, instances where a particular concept applies. Negative exemplars, also necessary for concept formation (Bruner, Goodnow, & Austin, 1956) are rarely noted. It is, therefore, not surprising that students leave instruction in chemistry with little idea of the range of applicability of the concepts and theories they have learned.

It can be argued that skill in applying epistemological judgments to scientific presentations may be *the* crucial skill in science-related reasoning for the average person to acquire. Social issues having scientific components confront us with increasing regularity. How is one to assess the relative merits of competing scientific positions? Science courses that explicitly deal with such critical reasoning within the context of the other varieties of knowledge can develop such skills in students, incidentally also giving the student a more authentic view of the development of the field (Martin, Kass, & Brouwer, 1990).

Not all theoretical propositions within science have equal “value” in adding to our understanding. Accounts of attempts to improve this understanding and the relative success and failure of various ideas can do much to provide the student with insight into science as a human activity. In one sense all the other perspectives may be viewed as varieties of epistemological perspective.

F. Social Reconstruction Perspective

Understanding of the sociopolitical contexts and uses of scientific knowledge is often mentioned in the context of scientific literacy. As with epistemological perspectives, evaluative dimensions are salient here. Social, political, and economic components of scientific knowledge, for example, areas of inquiry to be developed or closed, scientific research that is classified and/or developed with the support of the military, the ethics of nerve gases, and a host of other issues of the uses and abuses of scientific knowledge, warrant examination. The idea of neutral, value-free knowledge is increasingly seen as a myth. Contemporary science courses need to acquaint learners with some of the current (and historical) dilemmas that have a science component.

G. Psychological Perspective

All of us—including students and scientists—participate in constructing our ideas about the world. This perspective on knowledge values the personal meanings and interpretations held by persons as a result of their participation in the process of construction. Personal relevance and the ability to use the ideas in interpreting specific situations, making decisions, and solving problems are viewed as outcomes of such knowledge. Termed the generative learning model (Osborne & Wittrock, 1985) and based broadly on constructivist theory, the nature of personal science knowledge frameworks and alternative conceptions or explanations are currently active areas of research (White & Tischer, 1986). While the extent of individual capacity to assimilate and compartmentalize inconsistent information has been noted by teachers as well as researchers, its effects on the ability of individuals to integrate such pieces is not well understood. Perhaps what should be studied are persons

who have performed such integration in a functionally productive way, that is, the nature of scientific “talent” or scientific intuition as an adjunct to identifying and describing the various personal conceptions that the population at large may hold.

What attracts individuals to a given field? What are the characteristics of productive collaborations, and how do centers for a particular line of research develop? What factors influence intellectual commitment to a particular theory or problem area? How is the “business” of science, for example, patents, publication, organization of the research team, carried out, and are there differences here in the pure and applied areas?

H. Pedagogic Perspective

As noted earlier, the codification, standardization, and transmission of scientific knowledge involves modifications along the way. What is included, what is omitted, and what is emphasized is a function of the orientation of the person toward the other varieties of knowledge enumerated here. The relative influence of the other perspectives may result in curricula with somewhat different emphasis for the training of research scientists, applied scientists, engineers, other science-related occupations, for example, pharmacy, food sciences, or science teachers. How does the context in which one learns science (pure science, engineering, applied courses, honors thesis, general education, etc.) influence how one presents the key ideas to others—one’s choice of sequence, examples, and language used?

Some preferred pedagogic approaches and modifications may also evolve as a result of teaching experience. It is widely accepted that some ideas, for example, atomic theory, are introduced in an historical context while others, for example, reaction mechanisms, are rarely treated in this manner. Some ideas, for example, “diagrams” of atoms, appear in chemistry textbooks primarily as pedagogic rather than as scientific entities. It might be helpful to point out to the learner when such pedagogic simplification and generalization is taking place and the purposes that it serves. The same might be said for the analogies and metaphors that are introduced as aids to description and understanding. Appreciation of the power of a good model or metaphor is an important element in scientific thinking.

Psychological and pedagogic perspectives on knowledge are often interrelated and the psychological can at times act as a barrier to the pedagogic. The portrayal of molecular geometry on the printed page is a common example of such a problem in chemistry teaching, as is the presentation of the generic plant and animal cell in biology. Despite one’s best efforts, the conception becomes distorted and its perceived relationship to the actual behavior of these entities vague and inconclusive.

I. Historical Perspective

The understanding of key concepts in science and the language used in conjunction with these concepts may be enhanced by tracing their historic roots. Sometimes the story is “improved” in the retelling, not always to good effect. For example, the history of chemistry is usually portrayed as originating in alchemy. While such an historical emphasis might intrigue the learner, it fails to give account of the extensive applied chemical knowledge that has

existed in human society since ancient times, for example, preserving of foods, fermentation, dyes, medicines, the making of paper, cloth, glass, pottery, and numerous other items. Chemistry has been and to a significant extent remains today a practical science. It is also in this context that problem solving in chemistry is referred to as knowledge-rich task.

Clearly the evolution of science is one of the great adventures of the human imagination. In this sense, some acquaintance with the origins of our key ideas and the men and women who advanced them is a part of our heritage. The revisionary nature of science may also help the graduates of our science courses to understand what it is important to remember and what can be safely forgotten, that is, to develop some sense of intellectual self-knowledge relative to the field.

The Epistemology of Curricular Discourse

The above represents a brief exposition of some of the perspectives that may be taken on knowledge in science. Other possibilities are not ruled out. Each perspective involves value judgments about the kind of knowledge it encompasses and represents a voice in contemporary curriculum discourse. The compilation of the normative perspectives presented here describes a greater range of knowledge production as a part of science than is usually the case. The second set of five normative perspectives underlines the current preference among curriculum developers to view context as a part of the content. It is also recognized that different groups—researchers, graduate students, teachers, undergraduates, high school students, and elementary students—have a qualitatively different experience of the subject. Each begins with a different perspective.

A curriculum presents a learner not only with a perspective of the discipline as it was and currently is, but also of what it will be (or should be). How a particular discipline within science is portrayed as a potential area of science is also viewed as important, given current awareness of the underrepresentation of women and other groups in science-related fields (Sjoberg & Imsen, 1988; Kahle, 1988).

The growth of the scientific enterprise itself is contributing to the making of decisions about what to include, what to leave out, and how it should be organized in an increasingly problematic environment. When such an undertaking is extended to a finite entity such as a school curriculum, the existence of a basis for selection, whether explicit or implicit, that represents a workable degree of consensus among the stakeholders becomes of practical as well as philosophical importance. Programs that are perceived as “too different” from the prevailing orientation receive little support and are quickly replaced. Yet the idea that the focus on the concepts and theoretical principles of a science discipline, while perhaps still the prevailing orientation, is not of itself a necessary orientation, is gaining a foothold in many parts of the world (Fensham, 1988).

How might these perspectives be reflected in contemporary science curriculum in a coherent and pedagogically sensible way? An early interpretation of the question focused on making the dominant orientation explicit. Walker (1971) suggested that the “platform” of curriculum writers be set out

as an explicit part of the curriculum material. Connelly (1972) recommended that any curriculum should present a sufficiently clear exposition of its epistemological basis to permit a clear choice among alternatives. The teacher, school system, or government education ministry can then choose among the available perspectives and implement that particular view in a way appropriate to the characteristics of the setting. The variety of theoretical, applied, environmental, and science-technology-society oriented science programs that are currently in existence or under development attest to the viability of this approach.

Another approach is also possible. It should be pointed out that just as it is possible for an individual to hold a variety of perspectives on the nature of knowledge, including knowledge in the scientific and technological realm, curriculum and instruction can also reflect a multiplicity of perspectives within a coherent organizational framework. No one perspective, no matter how well developed, is adequate in reflecting the plurality of perspectives that can be used in relation to the subject. Indeed, it could be argued that study of one single science subject or specialization is itself not a sufficient vehicle for promoting an awareness of science. We live in a pluralistic world, with numerous alternatives for approaching it and learning to cope with it, and students need to be taught how to examine matters from a number of alternative perspectives. The linear, cumulative, top-down ways of thinking and of representing science are declining in usefulness in the present human context and, at some level, our high school students are aware of this.

A more immediate practical problem is the tunnel vision that quickly sets in when only one perspective is emphasized, whether it be societal, historical, theoretical, or whatever. No one perspective can be clearly designated as the "correct" one. All are right and all are wrong at the same time, but all are useful in that they represent different ways of viewing the subject and different starting points for inquiry. Students can be taught how to approach science with this type of orientation in order to think in an integrated, holistic way about the nature of science. Such perspectives are not mutually exclusive, but interact in many subtle ways.

Can this be done within the framework of a single curriculum? Can this be done to produce a coherent integrated course, or will the product be piecemeal, fragmented, and lacking in academic rigor? Clearly this is a question that cannot be answered in simplistic terms. Various alternative ways of approaching a multiperspective curriculum organization need to be devised, implemented, and assessed. The view that since knowledge is relative hence it does not matter what we teach, is *not* what is being said here. Obviously, it does matter, but what and how to teach those aspects of science that reflect the current nature and importance of the field in ways that are meaningful to more than the college bound in the area requires innovation and exploration.

Roberts (1982) has developed the notion of curriculum emphasis as an approach to developing a multiperspective framework for science curriculum. A program entitled *STS Chemistry* (Jenkins et al., 1989), among others, has used this idea as an organizational rationale in a way that operationalizes the approach for teachers. Various Canadian education min-

istries are also examining this rationale, particularly in the context of science-technology-society oriented curricula (Alberta Education, 1990).

Questions about what perspectives and whose perspectives should prevail, what the value and contextual dimensions would look like at any given point in time, and what contribution the teacher needs to make in response to local demands and changing circumstances will likely be with curriculum developers who are experimenting with various multiperspective approaches for some time.

The Epistemological Triad

A final and perhaps most fundamental question to be considered in the context of the present discussion of evolving curricular complexity involves the contribution that the student makes in developing her or his own understanding of science. How can we educate the learner to respond as sensitively and intelligently as possible to the complexities inherent in doing science, communicating science, and learning science or, for that matter, any other discipline? How does a coherent and functional world view develop?

Both professional experience and countless achievement tests support the hypothesis that a great deal of the science learned in schools is memorized using various rote learning strategies but is not understood by the students. Yet students, like people in general, attempt to make sense of the information they receive from their environment by relating it to knowledge that they already have. The outcomes of these attempts may provide mixed results (Fensham, 1983).

One approach that is meeting with acceptance among science teachers is the development of various metacognitive skills in students in order to increase their self-awareness as learners. The Peel Project (Baird & Mitchell, 1986) in Australia has explored this area in relation to increasing the effectiveness of student learning behaviors with some success.

The question of how students can come to understand—not only to know what it is they know, but also how they come to know it—also emerged within the context of a classroom-oriented approach to the development of a secondary school chemistry program (Jenkins et al., 1981) that questioned many of the traditional views of curriculum and the features of curriculum materials. In the course of a detailed epistemological analysis of the curriculum material as it went through various revisions in the development and classroom trial process (Jenkins, 1987) an epistemological relationship emerged that serves to link the curriculum in practice (i.e., “text” in the general sense) and the students. As currently visualized, the elements in this *epistemological triad* are:

- a. *substantive knowledge*—this constitutes the “text” in an epistemological sense;
- b. *methodological knowledge*—the method by which the student is to establish the validity of the textual assertion;
- c. *action component*—the requirement of the student to respond to the text by producing other knowledge.

The labels for a, b, and c remain problematic. The triad may also be described in terms of (a) pedagogy, (b) process, and (c) epistemology in the

corresponding dimensions above. In relation to science teaching, the three questions considered might be: (a) What is known? (b) How did scientists come to know this? (c) How am I to come to know this, that is, how am I to respond to this by producing new knowledge for myself? Some would label the latter as "coming to understand." Figure 2 portrays some possible linkages in an epistemological structure for understanding a concept in science.

All three elements of the epistemological triad are either explicitly or, more often, implicitly present in curriculum as it is played out in the classroom. This presence is dynamic in nature, characterized by interaction and development. The student's epistemological views both of the epistemological features of what is to be learned and the nature of herself or himself as a learner influence the learning outcome. For example, a student who views science as a collection of neutral facts may interpret the personal action component of a science learning task as one of getting the right answer. A student who views science as being grounded in human experience may interpret the personal action component as one of figuring out how the knowledge is created. Both may be working on the same laboratory exercise or assignment.

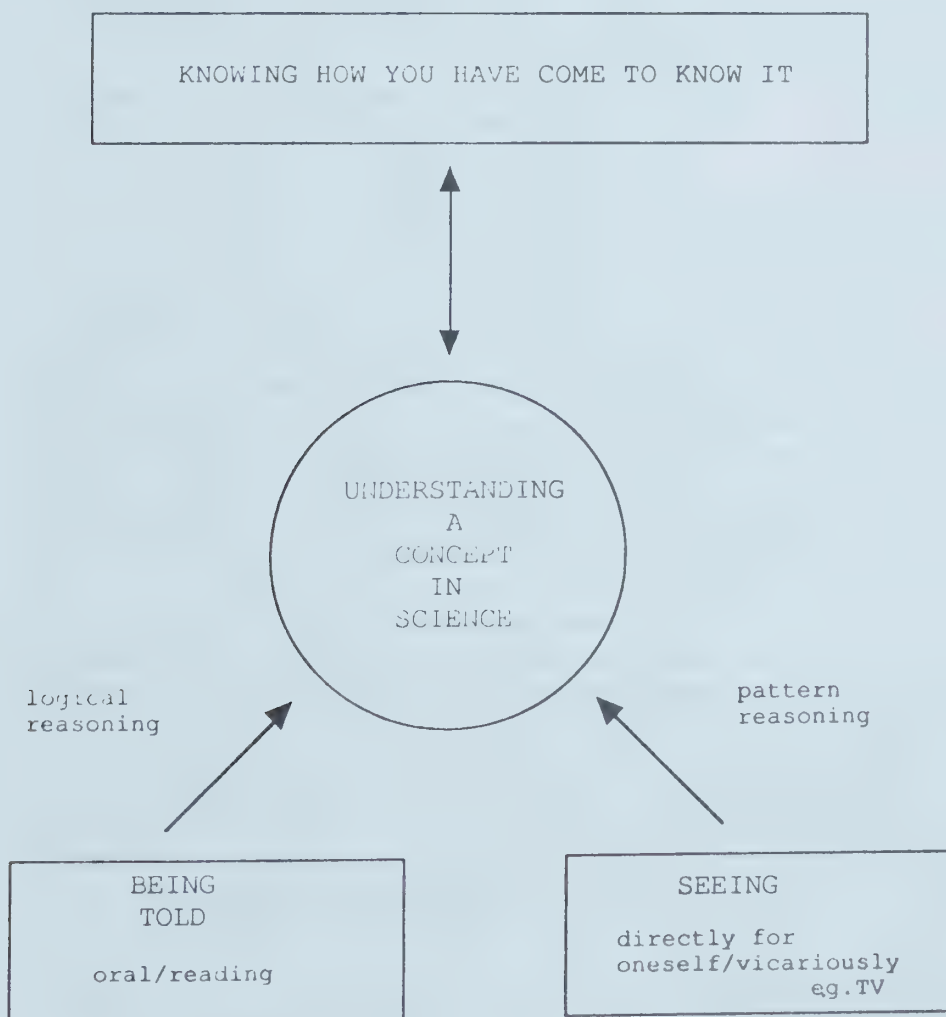


Figure 2. An epistemological structure for understanding a concept in science.

From a curriculum standpoint any curriculum emphasis or normative perspective on knowledge needs to be supported by evidence of epistemological content. As an example, given the emphasis placed on scientific theory and theoretical ways of knowing in science curricula, it is noteworthy that the epistemological question of what ways of knowing are used to derive a theory is rarely addressed in science curricula. Is it a surprise, then, that students fail to see any connection between theoretical science and the “epistemology in practice” of the real world?

Curricular Complexity and Pedagogic Reality

Whether curriculum in science will continue on a path toward increasing complexity or multiplicity of competing emphases and perspectives or evolve to a new metalevel of coherence will ultimately rest, as do most curricular questions, on what this means in the classroom. Some teaching techniques have been invented and are continuing to be invented to deal with specific aspects of this complexity, for example, science-technology-society issues analysis strategies. At a metalevel, there seems to be some promise of coherence in viewing the matter of curriculum content from an epistemological perspective. There is evidence (Jenkins, 1987) that this can be achieved within the constraints of a conventional teaching setting, particularly if classroom teachers are actively involved in writing the curriculum materials and in developing the teaching strategies to do this.

Schools are expected to fulfill a number of often competing social functions. In the science area, Fensham (1988) identifies two clusters of such functions as:

- a. political, economic and subject maintenance;
- b. cultural, social and individual.

The potential for curriculum competition, change, and evolution when the varieties of normative perspectives it is possible to take on a domain of human knowledge are juxtaposed with the competing social functions that schooling is to serve suggests that the field of curriculum and instruction will likely be an active one for some time to come in the realm of science education. As a start, we are beginning to identify some of the dimensions of the problem as it seems to exist today.

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Developing Autonomous Learners

Recent developments in cognitive psychology and education indicate that students who demonstrate autonomous or self-regulated learning are better equipped to promote their own academic achievement. In this article the concept of autonomous learning is first briefly described. Then an instructional approach to developing autonomous learners is presented including its underlying assumptions, instructional model, and teacher training procedures, as well as some research findings and anticipated future development.

Since about the beginning of the 1960s there has been an increasing interface of cognitive psychology and education. Evidence of this can be found in the emphasis now being placed on the development of learning/thinking strategies in educational assessment and instruction. The recent upsurge in interest in autonomous learning or self-regulation (McCombs, 1989; Paris & Byrnes, 1989; Whitman, 1990; Zimmerman & Schunk, 1989) is a result of this movement.

A number of papers are available in the literature addressing the issue of self-regulation and autonomous learning (see, e.g., Zimmerman & Schunk, 1989). This article briefly discusses the concept of self-regulation or autonomous learning and then outlines an approach to instruction we have been working on at the University of Alberta for the past 10 years. The approach, *Strategies Program for Effective Learning/Thinking* (SPELT), has as its goal the development of an autonomous learner.

The Concept of Autonomous Learning

The key feature of what makes an autonomous learner appears to be the independent self-control of one's cognitive as well as affective resources and activities. This position is supported by a number of researchers and theorists. For example, Paris and Byrnes (1989) conceive the self-regulated learner as one who seeks challenges, overcomes obstacles, sets realistic goals, and utilizes a battery of resources in approaching tasks with confidence and purpose. They see the hallmark of a self-regulated learner as combining positive expectations, motivation, and a wide range of strategies for solving problems. The view of the child as "theorist" is emphasized. According to this view, the child's theories of self-competence, effort, and academic tasks interact to develop or inhibit self-regulated learning.

Similarly, Palinscar, David, Winn, and Stevens (1991) depict the self-regulated or autonomous learner as one who uses with flexibility three main kinds of knowledge: knowledge of strategies for performing learning tasks

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efficiently; metacognitive knowledge of one's own learner characteristics and task demands; and real world knowledge. Moreover, they implicate motivation as they suggest that the self-regulated learner not only utilizes the above three knowledge bases, but as well demonstrates the motivation to employ the knowledge effectively.

McCombs (1989) also views the self-regulated learner as a function of the development of cognitive and metacognitive abilities for processing, planning, and regulating learning activities, as well as for controlling and regulating affect and motivation. McCombs, however, explicitly places greater emphasis on the importance of a positive affect and motivation in the emergence of the autonomous learner. Some other researchers (e.g., Dweck, 1986; Skinner, Chapman, & Baltes, 1988) also contend that students' beliefs, expectations, and attributions with respect to academic tasks have a significant impact on their learning and indeed on whether or not they are able to become autonomous learners.

Self-regulated or autonomous learning, then, appears to mean that individuals are able to independently manage their learning and affect including motivation, so that learning is efficient, effective, and satisfying (Paris & Byrnes, 1989).

In contrast to this "ideal" model of the autonomous learner, there is a relatively large data base in the literature characterizing ineffective learners as those who often fail to demonstrate the flexible use of various knowledge bases as well as failing to display positive belief systems with respect to their personal competence and control of the learning process (cf. Paris & Oka, 1986). As a result, numerous instructional programs aiming to improve students' learning and thinking have been developed (cf. Nickerson, Perkins, & Smith, 1985).

The SPELT Cognitive Education Approach

For the past 10 years we have been involved in the development and evaluation of an instructional approach to teaching metacognitive and cognitive strategies along with the control and regulation of affect and motivation. This instructional approach is called *Strategies Program for Effective Learning/Thinking* (SPELT). In the following sections, the underlying assumptions of the approach, its instructional methods, teacher training procedures, and research findings and future development are described.

Underlying Assumptions

The underlying assumptions of our approach are that learning is an active, constructive process that involves the individual's use and management of his or her own cognitive processes. As the overall goal of the approach is to develop a self-regulated or autonomous learner, the instructional process utilized is of major importance.

The dominant model in the majority of cognitive and metacognitive instruction approaches, however, has been the instructional system assigned or teacher imposed. Typically, the strategies are designed and tested by experts and then taught to students as recipes for dealing with a variety of problems. Within this framework there is virtually no opportunity for students to participate in determining which cognitive or metacognitive strategies are

appropriate for different purposes and varying conditions. This approach also reinforces a passive learning approach as well as reinforcing an external locus of control, both of which run counter to the development of an autonomous or self-regulating learner.

In contrast, the SPELT approach we have been developing utilizes a model of instruction in which the student is ultimately given the responsibility of determining if a strategy is needed, what strategies are appropriate, and how to generate, implement, and evaluate them in a way that maximizes problem solution.

Cognitive and metacognitive strategies are viewed in our approach as internally organized skills or control processes by which individuals regulate their behavior (both affective and cognitive). An individual's knowledge base regarding cognitive and metacognitive strategies and procedures for utilizing these along with the knowledge of what, when, where and why to utilize a particular strategy or combination of strategies is seen as the vehicle by which the individual may become a self-regulated learner.

Within the SPELT approach we have imbedded a general teaching orientation in which the teacher's goal in all planning and instruction is to actively involve the student in his or her learning. The teacher acting as a mediator in the learning process attempts to have students become more aware of their own cognitive and metacognitive processes as well as aware of their motives and affect as it affects their learning. In acting as a mediator the teacher leads students to discover and deduce rather than teaching facts to them, as well as constantly challenging students to be more critical, systematic, evaluative, and strategic in their behavior and attitude toward learning.

Instructional Methods

How can the teacher be successful in acting as a mediator? We incorporated three major types of instructional methods into the program to nurture the students' learning and motivation that would lead to self-regulated learning (Mulcahy, Marfo, & Peat, 1984). The first type is direct instruction and explanation of learning strategies that may help children modify incomplete or erroneous theories they may hold with respect to self-regulated learning. The second type of instruction emphasizes peer tutoring and dialogues about learning. Instruction here also may involve Socratic dialogues, apprenticeship models, and dialogical learning. The third category of instruction involves cooperative learning involving group discussion, argument, and co-construction of appropriate cognitive and metacognitive strategies. These three types of instruction have recently been suggested to be effective innovative methods to assist teachers in developing self-regulated learners (Paris & Byrnes, 1989).

With these three types of instruction integrated into our program, the instructional approach involves a progression from the lowest level of strategy acquisition (teacher imposed) to the highest level (student self-generated). Accordingly, we have developed three phases of instruction in which the teacher taking the role of a mediator assists the students in becoming increasingly more in control of the learning process leading them ultimately to autonomous learning.

The first phase of instruction involves the direct teaching of cognitive and metacognitive strategies that are program recommended, teacher identified, or teacher generated. This phase of the instruction approach has as its goals the development of a repertoire of metacognitive and cognitive strategies, along with making students more aware of the benefits of strategic behavior. As well an emphasis in the instruction here is on developing positive perceptions of self-competence along with attributional beliefs that emphasize personal control and competence. During this phase of instruction the source of control of the strategies resides with the instructor.

Some researchers have criticized cognitive strategy instruction approaches as involving the mere memorization and rote learning of strategy steps and application (cf. Kronick, 1988). If instruction were to remain at this first level, it is possible that it would encourage many of the negative characteristics of learning such as passivity and external locus of control. However, it should be noted that "recent research ... indicates that the process of knowledge transformation and construction occur even when children engage in drill-and-practice activities" (Harris & Pressley, 1991, p. 393). More importantly, our approach includes two more advanced phases of instruction.

The second phase of instruction in the SPELT approach is what might be considered the transfer and generalization phase. Instruction here emphasizes systematic transfer and generalization of the strategies built in the first phase of instruction across various tasks and content areas. The major mode of instruction moves to a more dynamic interactive and reflective one in which the teacher relies heavily on Socratic dialogues to stimulate students to reflect and reconsider their views, as well as encouraging them to develop explicit understanding of tasks, strategies, and their own motives, feelings, and beliefs regarding these. The teacher is encouraged to utilize a number of other methods in conjunction with this dialogue including paired and group problem solving, thinking aloud, cooperative group, brainstorming on the pros and cons of various cognitive and metacognitive strategies for different tasks, situations, and purposes. The students are led through teacher and group dialogue to become more aware of their own task approach and strategy use as well as others, and use this to critically analyze and then extend or modify their own personal strategies or the strategies presented to them.

By the time students are functioning in the third phase (student self-generation of strategies) of instruction, they have developed a knowledge base regarding various cognitive and metacognitive strategies along with knowledge of their procedures for application, including an awareness of where, when, and why they should be used. This then serves as the knowledge base for student self-generated strategies. During this phase of instruction content is presented to the students with minimal amounts of teacher guidance as to how to complete the task. The teacher, utilizing the Socratic dialogue, centers discussion around an analysis of how the task was completed or is being approached by different students, analyzing of task requirements, alternative approaches, and ways of determining the relative effectiveness of

possible strategies. Here again, paired and group problem solving thinking aloud are recommended.

A variety of cognitive and metacognitive strategies are integrated into the approach, including strategies that are effective for retaining information, comprehending information, communicating information (written and spoken), controlling affect and motivation, general and specific problem solving, and numerous others (see Peat, Mulcahy, & Darko-Yeboah, 1989, for a listing of strategies taught).

Inservice Training Procedures

The successful implementation of SPELT depends largely on the teacher. Therefore, inservice training is an integral part of the approach. The inservice training of teachers was originally conducted over a five-full-day session broken into two blocks. Part One was a three-day session and was followed by Part Two about three weeks later.

During Part One training, teachers are introduced to the program's theoretical framework in cognitive psychology, to the three-phase instructional model, as well as the practical applications of the model. Throughout Part One training teachers are continually exposed to cognitive theory of learning. Teachers are instructed to focus on the development of positive self-competence and attributional belief systems of the students in conjunction with instruction in cognitive and metacognitive strategies.

Part Two Training has as its major emphasis the systematic transfer of students' strategic repertoire established earlier to other situations, settings, and applications (i.e., generalization). As the applications of the various strategies change, teachers are instructed to discuss with their students these strategy adaptations, modifications, and/or extensions, emphasizing how these changes effect their use. Students thus see that once a strategy is learned it is *not* carved in stone, but can be modified. This personalizes the strategies and acts as a stepping stone in the students' ability to self-generate effective learning and thinking strategies: the goal of the final phase of instruction.

During Part Two training, teachers are instructed in the principles and use of *Socratic dialogue*, which involves an interactive relationship between teacher and students with the students being led through questioning to discover for themselves. Socratic dialogue is operationalized based on the work of Collins (1977), specifying guidelines such as: (a) starting with what is know, (b) asking for multiple reasons, (c) forming general rules from specific cases, (d) picking counter examples when insufficient reason is given, (e) using extreme case examples, (f) probing for the difference between cases, and (g) using prediction questions. Key teacher behaviors that facilitate Socratic dialogue are also recommended (e.g., 5-10-second wait time). It is important to note that Socratic dialogue is the chosen methodology for discussion centering around the strategy use of students, but it becomes readily apparent to teachers how this type of dialogue can enhance the thinking skills of students during any classroom discussion, regardless of content.

As the teachers recognize some of the specific strategies or methodologies presented, they begin to see that some aspects of their past classroom teaching has emphasized the teaching of learning/thinking skills, but that instruction in this area has usually been unconscious and/or incidental, lacking a precise goal or direction. This recognition aids in their conceptualizing "cognitive education," in spite of their antitheory bias, as nonthreatening and achievable in their classrooms. Also, during the workshop the teachers themselves actively practice the strategies and engage in paired problem solving, cooperative learning, and Socratic dialogues by being placed in the role of students as the presenter's instructional approach moves along the SPELT continuum.

This model allows the teachers to experience first hand the *process* that parallels what their students will undergo as the approach is implemented in their classrooms. The process allows the teachers to freely express their doubts and concerns throughout the inservice, a factor shown to be important in facilitating receptivity to change. Placing the teachers in the student position also has the effect of concretely demonstrating to them that they too should continue to develop their thinking skills and, in that sense, places them in the dual role of learner and teacher. It also serves to emphasize their responsibility as role models of systematic and strategic problem solvers.

We have over the past seven years experimented with a variety of inservice training formats for the instruction of teachers, counselors, psychologists, and administrators. The optimum appears to be three days of intensive instruction followed in about one month by one full day and then two months later another full day.

A Longitudinal Study

The SPELT cognitive education approach has been extensively evaluated in a three-year longitudinal study jointly supported by Alberta Education, Government of Alberta; Faculty of Education, University of Alberta; and school jurisdictions in Alberta. The detailed results of this study have been reported elsewhere (Mulcahy et al., 1989; Mulcahy, et al., 1991). The study involved two years of experimental instruction followed by a one-year maintenance period where all instruction was withdrawn. Nine hundred students (learning difficulties, average, and gifted) initially in regular grade 4 and grade 7 experimental and control classrooms were followed over the course of three years. The overall results of the study were very encouraging both from the perspective of student change as well as from the perspective of the teachers, parents, and administrators.

The three-year longitudinal evaluation was implemented in two phases (i.e., phase I: 1984-1987; and phase II: 1985-1988). We utilized a repeated measures factorial design involving three types of instructional programs (Instrumental Enrichment, SPELT, and Control); three categories of students (gifted, average, and learning-disabled); two initial grade levels (grade 4 and grade 7), and four repeated measures: pretest in the fall of the initial year, and three posttests in succeeding May/June periods, corresponding to the end of grades 4, 5, and 6 at the elementary level and 7, 8, and 9 at the junior high level.

Teachers volunteered for any one of the three instructional conditions. The research team then randomly assigned them to an instructional condition with the constraint that a given school could only be involved with one instructional condition.

Teachers assigned to the control condition (traditional instruction) were told to teach as usual, whereas teachers assigned to the two cognitive education procedures received inservice training from project staff prior to giving strategy instruction. Students involved in the two cognitive education programs received a minimum of 120 minutes of strategy instruction per week over two school years. Strategy instruction was followed by one year of maintenance, during which all strategy instruction was withheld.

Four categories of instruments were utilized in this study (full details in Mulcahy et al., 1989):

1. *Cognitive ability* was assessed by the Canadian Cognitive Abilities Test (CCAT), which includes verbal, quantitative, and nonverbal reasoning abilities.
2. *Academic achievement* was assessed by the Canadian Achievement Test (CAT), which consists of two separate batteries measuring skills in reading (vocabulary, comprehension) and mathematics (computation, concept/application).
3. *Affective perceptions* involved measures of perceived competence in four areas (cognitive, social, physical, and general); attitudes toward the self in social, academic, family, and personal areas of experience; and students' beliefs regarding responsibility for outcomes in academic achievement situations.
4. *Cognitive strategies* were assessed in the areas of:
 - a. *Reading awareness*, which included students' awareness of the evaluation, planning, and regulation of skills involved in reading.
 - b. *Reading strategies*. A cloze task was developed to evaluate students' reading-comprehension abilities and strategies; words were systematically omitted, and students required to fill in the blanks.
 - c. *Comprehension monitoring*. An error detection task, designed to assess students' comprehension monitoring skills, required students to detect anomalous information in the passage. Awareness of faulty comprehension is taken as a measure of students' comprehension monitoring.
 - e. *Perceived problem solving ability*. Heppner and Petersen's (1982) Problem-Solving Inventory (PSI) was adopted to examine the underlying dimensions of students' perception of their real-life, personal problem-solving process.
 - f. *Problem solving strategies*. A problem solving task was developed to assess students' problem solving strategies in mathematics. This task requires students to think aloud as they try to solve the given math problems.

Most of the above measures were implemented in both the pretest and posttest phases, with the exception that measures of cognitive strategies were not available at the pretest point and were administered at the posttest points only.

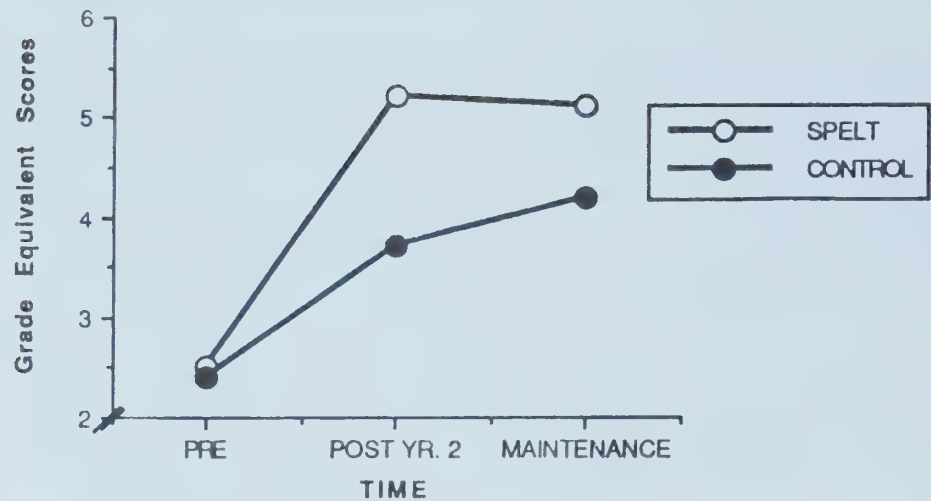


Figure 1. Reading comprehension: Grade 4 learning disabled.

Teacher, administrator, and parent perceptions of program implementation and effects were also evaluated each year.

Research Findings

Because of the large amount of data, only the results with respect to the SPELT approach are reported here. To provide some idea of some particular changes observed, a brief summary of the results for reading comprehension performance, metacognitive awareness in reading, comprehension monitoring, along with teachers' perceptions are described in the following section. More complete results are provided in Mulcahy et al. (1989), including statistical details.

Grade 4. The grade 4 learning disabled SPELT students displayed greater gains than their control counterparts on the standardized measure of reading comprehension after two years of instruction as this difference tended to be maintained at maintenance (see Figure 1).

At the end of the three years, the SPELT students were performing at about one grade level higher than control subjects (scaled score analysis demonstrated the same effects). These changes were coupled with changes in strategy areas of reading, particularly with respect to metacognitive reading awareness (see Figure 2).

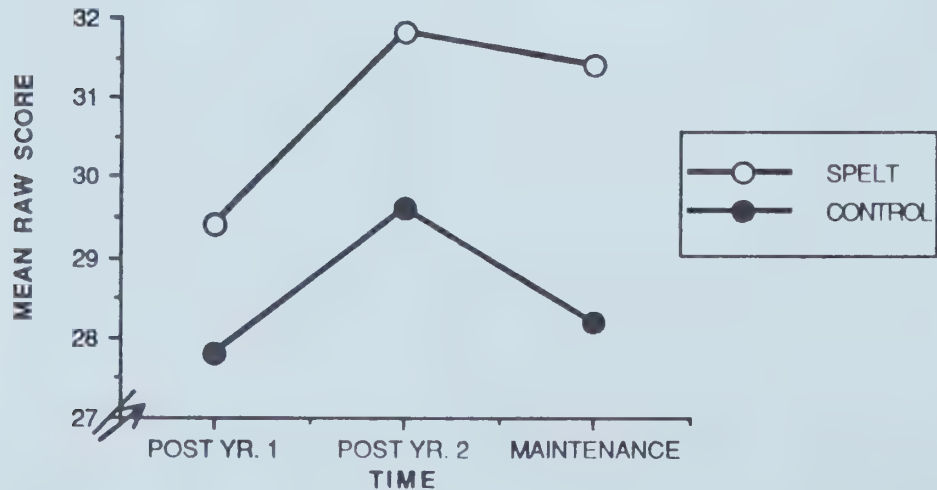


Figure 2. Metacognitive reading awareness: Grade 4 learning disabled.

The average achieving students demonstrated few experimental effects on the standardized measures of reading comprehension; however, some significant group differences were obtained with respect to metacognitive reading awareness, the SPELT average students generally outperforming their control counterparts at all test points over the three years. This was the case as well with respect to comprehension monitoring (see Figure 3).

Gifted students in the SPELT program did not differ from their control counterparts on standardized measures of reading. There was indication, however, that the SPELT approach did have a positive impact on metacognitive awareness in reading as differences were noted at all three test points in favor of SPELT subjects. This difference was also observed for the comprehensive monitoring performance of the two groups.

Grade 7. A trend was observed for differences in gains in reading comprehension in favor of the SPELT students as measured by the standardized test of reading (see Figure 4). The trend was also evident with respect to the standardized measure of vocabulary (see Figure 5).

No significant differences were obtained with respect to metacognitive awareness in reading for the grade 7 SPELT group. However, the overall group mean followed the same pattern as that observed at grade 4 (SPELT

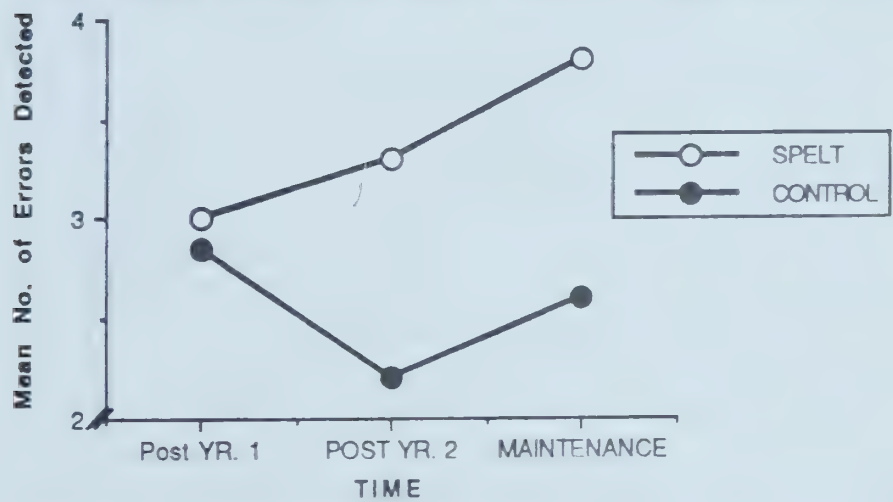


Figure 3. Comprehension monitoring: Grade 4 average students.

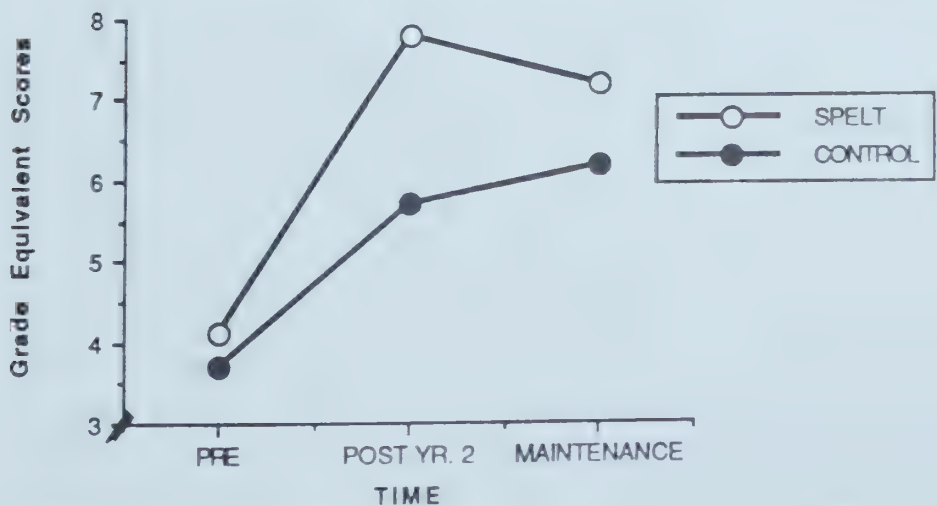


Figure 4. Reading comprehension: Grade 7 learning disabled.

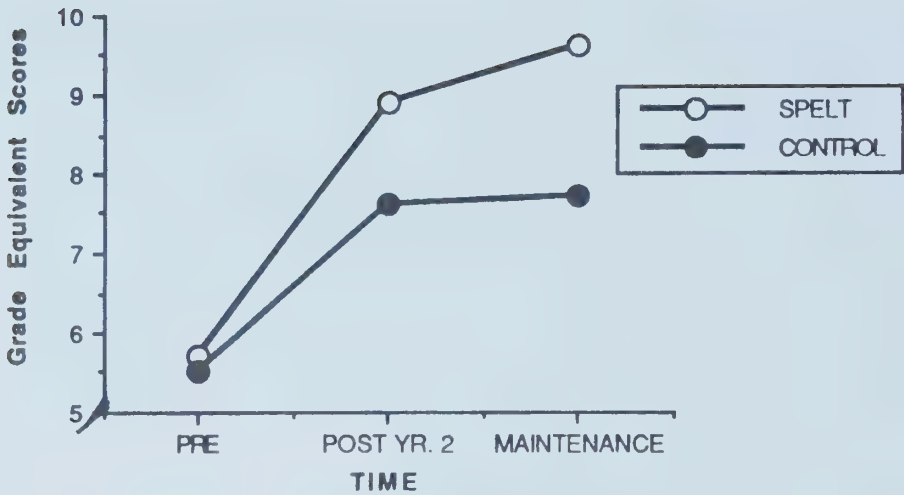


Figure 5. Reading vocabulary: Grade 7 learning disabled.

mean raw score= 33.4, Control mean raw score= 30.9). Overall differences were also obtained with respect to comprehension monitoring in favor of the SPELT students (SPELT mean raw score = 3.6, Control mean raw score = 2.7).

Average achieving grade 7 students in the SPELT approach did not differ significantly from control students on standardized measures of reading or on measures of comprehension monitoring and metacognitive awareness.

Gifted grade 7 students in the SPELT approach did not differ from control students on standardized measures of reading. Nevertheless, differences in favor of the SPELT students were observed on the measure of metacognitive awareness in reading (see Figure 6). The SPELT students also outperformed control students on the measure of comprehension monitoring, particularly at the end of the three years (see Figure 7).

In summary, the SPELT results for measures of reading comprehension and vocabulary, as well as metacognitive awareness in reading and comprehension monitoring, are encouraging. The lack of effects observed for grade 7 average achieving and to some extent grade 4 average students is somewhat puzzling. However, as we have argued elsewhere (Mulcahy et al.,

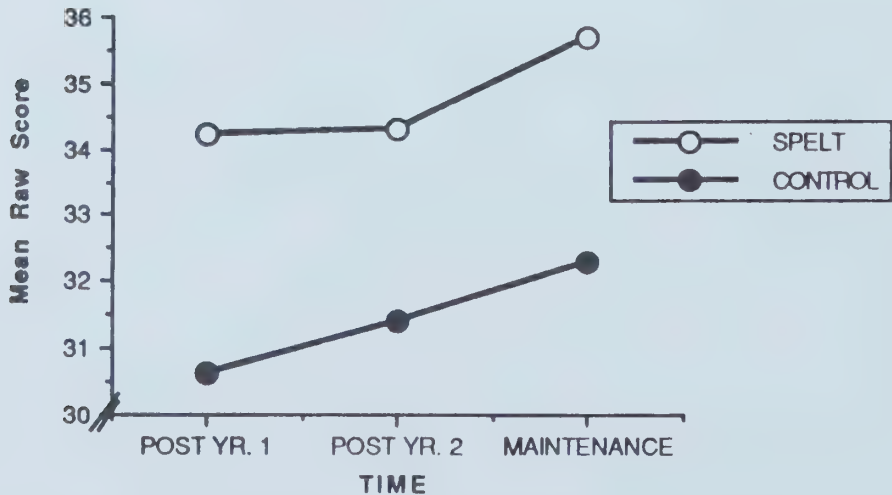


Figure 6. Metacognitive reading awareness: Grade 7 gifted.

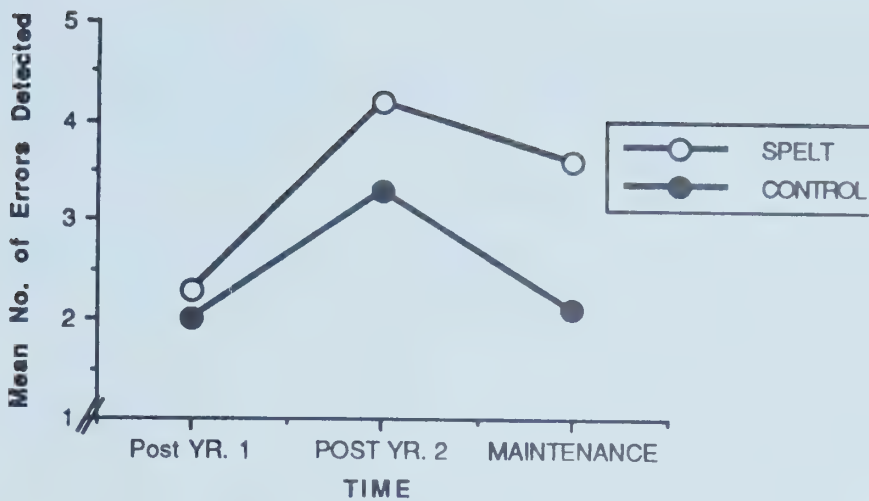


Figure 7. Comprehension monitoring: Grade 7 gifted.

1991), it might well be because average achieving students have a reasonably effective approach to tasks already and thus a greater effort is needed to change or refine their strategic approach, so they do not benefit from the first phase of instruction. Learning disabled students, on the other hand, may lack a systematic approach to tasks and thus benefit more quickly. Gifted students may perceive the usefulness of a more refined approach and thus use and extend the strategies more quickly, thus benefiting more from the final phase of instruction.

The above results by themselves have relatively clear implications for mainstreaming learning disabled and gifted students. The change noted here in the SPELT approach for both gifted and learning disabled students suggests that this instructional approach in regular classrooms may prevent some students from developing severe learning problems, therefore enabling them to function effectively in regular classrooms. The gifted students, as identified in this study, also appeared to benefit from this instruction in regular class settings.

This particular evaluation was quite conservative, as in the majority of situations only one or two teachers in a school were teaching using the approach at one grade level and in junior high usually in one subject level. If *all* teachers at each grade level were focusing on instruction in metacognitive and cognitive strategies, more comprehensive effects might emerge as students would be reinforced across grades and subjects.

In addition to the above experimental findings, it should be pointed out that the inservice training sessions have also been consistently evaluated over the course of the years with encouraging results. We have now inservice trained approximately 2,000 teachers, counselors, psychologists, speech language pathologists, and school administrators in Canada, Australia, and New Zealand. Teachers not only recommend this type of instructional training to their colleagues, but also a large number have suggested that this approach to classroom instruction be an integral part of the preservice training for all teachers. Many indicate that the approach has changed their teaching style and the way they view their students and the learning process.

Current Development

We are currently focusing on within-classroom, within-subject research in an attempt to delineate more clearly the problems and issues in implementation, as well as to determine the essential components of instruction that are critical to developing self-regulated learners in the classroom.

Teachers' perceptions is another area of further research we are planning to pursue in order to determine the effect this approach has on teachers' view of development, learning, and the teaching process as well as the nature of the classroom interaction patterns.

Finally, the implementation and evaluation of the SPELT approach is now being extended to cross-cultural research sites in Australia, New Zealand, and India. We are also currently exploring the further development of the approach with aboriginal students in Australia and Canada. The continued development and validation of assessment tools and approaches for metacognitive and cognitive strategy assessment within and across domains, including the social and affective areas, is an integral part of this further research. The longstanding goal of our research is to add to our knowledge regarding the nurturing of autonomous learning in a variety of contexts.

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